FINAL REPORT
HABITAT INVENTORY OF SCLEROCACTUS WRIGHTIAE AND OTHER ASSOCIATED SENSITIVE SPECIES

VOLUME I - TEXT AND PHOTOGRAPHS

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VOLUME I - TEXT AND PHOTOGRAPHS

Prepared for:

United States Department of Interior
Bureau of Land Management
Richfield District Office
150 East 900 North
Richfield, Utah 84701
Contract No. UT-910-CT5-2685

Prepared by:

Neese Investigations
4478 Zarahemla Drive
Salt Lake City, Utah 84124

(801) 277-0701

January, 1987

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ABSTRACT

Habitat inventory in search of Sclerocactus wrightiae under terms of Bureau of Land Management Contract No. UT-910-CT5-2685 was conducted during the 1986 growing season. The searched area consists of approximately 600,000 acres of federal land in portions of the Sevier River and Henry Mountain Resource Areas, Richfield District, Bureau of Land Management. Also looked for during the search for the cactus were Townsendia aprica, Pediocactus winkleri, Sphaeralcea psoraloides, and Schoencrambe barnebyi. In Study Area 1, 180 occurrences of Sclerocactus wrightiae are mapped and reported, these being distributed in 123 sections. In Study Area 2, 11 occurrences are mapped and reported, these from a total of 10 sections. In addition, 12 occurrences of Pediocactus winkleri in 9 sections, 10 occurrences of Sphaeralcea psoraloides in in 7 sections, and 10 occurrences of Townsendia aprica in 8 sections are mapped and reported. Population numbers, specific habitat characteristics, and known and probable distribution in the study area of the target taxa are provided. No occurrence of Schoencrambe barnebyi, nor habitat likely to support it, was found.

General botanical collection totalling over 600 numbers was conducted, especially of rare, poorly known, or obscure species. Discovered during the inventory was a new and undescribed taxon of Gilia. Formal description and naming of the new taxon is in progress.

ABSTRACT

HOW TO USE
THIS REPORT

HOW TO USE THIS REPORT

This document with supporting materials is necessarily complex because of data gathering and reporting requirements defined in the contract. It is designed to provide and cross-reference all distributional and ecological data gathered during the course of the study, and will serve to answer questions of several kinds. In order to familiarize the user with the organization, code designation, and cross-reference helps employed in the document, the following guidelines and explanations are provided.

CODE DESIGNATIONS

The area inventoried is large and the number of occurences discovered of target taxa are many. In order to allow orderly search and reporting, code designations which identify search forms (the Township Finding Forms) and the forms recording ecological data about occurrences of target taxa (Population Habitat Data Forms) have been employed. Two types of code designations are thus used. **The applications of these two codes must be kept in mind to avoid confusion while using cross-referencing aids.** The two code systems employed are explained below.

1. POPULATION CODES

These codes identify each population of target taxa. Each code consists of the first two letters of the genus and of the species as well as an arbitrarily assigned population identification number. Thus, "PEWI-2" refers to the second population of Pediocactus winkleri, while "TOAP-3" refers to the third population of Townsendia aprica.

In Study Area 1, populations are numbered roughly from north to south and west to east (as you would read a page of a book). Populations in Study Area 2, which was surveyed and reported after Area 1, are numbered from north to south. Thus, "SCWR-1" is the most northwesterly population of Sclerocacatus wrightiae in Study Area 1, while "SCWR-23" is the most southerly. The Sclerocactus populations in Study Area 2 are numbered starting with SCWR-24 for the northernmost population.

For each population, a locality name has been given to expedite recognition of the geographic area where it occurs. Thus, SCWR-9 (North Caineville Reef) indicates that the ninth population of Sclerocactus wrightiae occurs in the vicinity of the the north part of Caineville Reef, while SCWR-10 (North Caineville Mesa) indicates that the tenth population of the cactus occurs on the summit of North Caineville Mesa.

The following population codes are used:

Study Area 1

- for Pediocactus winkleri:

PEWI-1 (Hartnet Draw)
PEWI-2 (Dry Wash)
PEWI-3 (Notom)
PEWI-4 (Sandy Creek)

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For each population, a locality name has been given to expedite recognition of the geographic area where it occurs. Thus, SCWR-9 (North Clainville Mesa) indicates that the ninth population of Sclerocactus wrightiae occurs in the vicinity of the the north part of Clainville Mesa, while SCWR-10 (North Clainville Mesa) indicates that the tenth population of the cactus occurs on the summit of North Clainville Mesa.

The following population codes are used:

Study Area 1

- for Pediocactus wintheri:

PEWI-1 (Hermit Draw)
PEWI-2 (Dry Wash)
PEWI-3 (Motom)
PEWI-4 (Sandy Creek)

- for Sclerocactus wrightiae:

SCWR-1 (Middle Desert West)
SCWR-2 (Middle Desert East)
SCWR-3 (Willow Seep)
SCWR-4 (Moroni)
SCWR-5 (Coal Mine Wash)
SCWR-6 (The Notch)
SCWR-7 (Hartnet Draw)
SCWR-8 (Caineville)
SCWR-9 (North Caineville Reef)
SCWR-10 (North Caineville Mesa)
SCWR-11 (Neilson Wash)
SCWR-12 (Giles)
SCWR-13 (Lower Blue Hills)
SCWR-14 (Pinto Hills)
SCWR-15 (Dry Valley)
SCWR-16 (Hanksville South)
SCWR-17 (Hanksville North)
SCWR-18 (Notom)
SCWR-19 (North Blue Flats)
SCWR-20 (Town Wash)
SCWR-21 (East Blue Mesa)
SCWR-22 (White Point)
SCWR-23 (Sandy Creek)

- for Sphaeralcea psoraloides:

SPPS-1 (Moroni)

Study Area 2

- for Sclerocactus wrightiae:

SCWR-24 (Willow Springs)
SCWR-25 (Last Chance Ranch)
SCWR-26 (Solomon Creek)
SCWR-27 (Rock Springs Wash)

- for Townsendia aprica:

TOAP-1 (Interstate I-70)
TOAP-2 (Post Hollow)
TOAP-3 (Willow Springs)
TOAP-4 (Type Locality)
TOAP-5 (Last Chance Ranch)
TOAP-6 (Solomon Creek)
TOAP-7 (Rock Springs Wash)

These codes are utilized and cross-referenced in several places in this report, as follows:

Use of Population Codes in Volume I:

-- List of Figures, Charts, and Photographs:

For each population reported for each of the target taxa, a photograph is provided of the plant in its habitat. This photograph is referenced in the List of Figures, Charts, and Photographs by figure number, population code number and locality name, and page. The target taxa are treated in alphabetical sequence both in the text and in the arrangement of appended (Volume II) data forms.

-- Distribution Summary Maps:

A map for each species showing the location of each population is provided in the text. These mapped populations are identified by population code number and locality name on the map and/or map legend.

- for *Sclerocactus wrightiae*:

SCWR-1 (Middle Desert West) SCWR-13 (Lower Blue Hills)
SCWR-2 (Middle Desert East) SCWR-14 (Pinto Hills)
SCWR-3 (Willow Seep) SCWR-15 (Dry Valley)
SCWR-4 (Moroni) SCWR-16 (Hanksville South)
SCWR-5 (Coal Mine Wash) SCWR-17 (Hanksville North)
SCWR-6 (The Notch) SCWR-18 (Notom)
SCWR-7 (Hartnet Draw) SCWR-19 (North Blue Flats)
SCWR-8 (Caineville) SCWR-20 (Town Wash)
SCWR-9 (North Caineville Reef) SCWR-21 (East Blue Mesa)
SCWR-10 (North Caineville Mesa) SCWR-22 (White Point)
SCWR-11 (Neilson Wash) SCWR-23 (Sandy Creek)
SCWR-12 (Giles)

- for *Sphaeralcea psoralioides*:

SPPS-1 (Moroni)

Study Area 2

- for *Sclerocactus wrightiae*:

SCWR-24 (Willow Springs) SCWR-26 (Solomon Creek)
SCWR-25 (Last Chance Ranch) SCWR-27 (Rock Springs Wash)

- for *Townsendia aprica*:

TOAP-1 (Interstate I-70) TOAP-5 (Last Chance Ranch)
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For each population of each species, a photograph is provided of the plant in its habitat. This photograph, as referenced in the List of Figures, Charts, and Photographs, titled with the figure number and the population code number and locality name. For each taxon, the population pictures are in numerical sequence.

Use of Population Codes in Volume II:

-- Population/Habitat Data Forms

The population code number (but not the locality name) appears at the upper right corner of each population/habitat data form. The pages are arranged in alphabetical and numerical sequence. In many cases, inventory workers reported independently or on different days occurrence of the cactus of a given population. Thus there may be several data sheets for the same populations. These are identified by a letter code: for example population SCWR-1 is reported (by workers on two different days and from different sections) on forms 1A, 1B, 1C and 1D.

-- Township Finding Forms

The township finding forms which report inventory progress and findings on an area-by-area basis are cross-referenced to maps, photos and population/habitat forms. If any of the target taxa were located in that particular area that day by that worker, it is reported under "Comments", and the pertinent population/habitat forms reporting that occurrence are listed by population code number and locality name at the bottom of the page under "Cross References".

-- Maps

The set of USGS topographic maps which accompany this report show by color-coded dots each known occurrence of each of the target taxa. Occurrence clusters comprise a population, and each population is identified on the topographic maps by the population code number and locality name.

2. TOWNSHIP CODES

The inventory was designed with the township as the reporting unit. In the interest of brevity and ease in data entry, each township has been given a number code, from "1" in the northwest to "29" in the south (Study Area 1) and from 30-35 (Study Area 2). Each day's inventory effort was reported on Township Finding Forms using these numbers. Usually, several forms were prepared for each township; the sequence of forms for a given township are designated alphabetically. For example, Township 2 (T27S, R7E) has two forms, 2A and 2B, one of which was filled out by Neese on May 2, the other by Kass on May 27 (see Township Finding Forms section in Volume II).

-- Photographs:

For each population of each species, a photograph is provided of the plant in its habitat. This photograph, as referenced in the List of Figures, Charts, and Photographs, titled with the figure number and the population code number and locality name. For each taxon, the population pictures are in numerical sequence.

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The following township reference numbers have been used:

Study Area 1

Township & Range	Township Number	Township & Range	Township Number
T27S, R6E	1	T29S, R9E	16
T27S, R7E	2	T29S, R10E	17
T27S, R8E	3	T29S, R11E	18
T27S, R9E	4	T29S, R12E	19
T27S, R10E	5	T30S, R7E	20
T27S, R11E	6	T30S, R8E	21
T27S, R12E	7	T30S, R9E	22
T28S, R7E	8	T30S, R10E	23
T28S, R8E	9	T30S, R11E	24
T28S, R9E	10	T30S, R12E	25
T28S, R10E	11	T31S, R7E	26
T28S, R11E	12	T31S, R8E	27
T28S, R12E	13	T31S, R9E	28
T29S, R7E	14	T32S, R7E	29
T29S, R8E	15		

Study Area 2

Township & Range	Township Number	Township & Range	Township Number
T21S, R5E	30	T24S, R5E	33
T22S, R5E	31	T25S, R5E	34
T23S, R5E	32	T26S, R5E	35

These township reference numbers appear on the topographic maps which accompany this report, on maps of the Study Areas (pages 4 and 5), and on the distribution summary maps of each of the species. **Do not confuse these township reference numbers with the Population Code numbers of the target taxa.** By using the township reference number which appears in the upper right corner of each Township Finding Form, the "level of effort" and "findings" for any given area can be located easily.

SECTIONAL FINDINGS

Summary of occurrence of all target taxa in each township of the inventoried area is presented in Figures 88 and 89 (pages 104 and 105). Each section where each of the species is known to occur is listed. These charts provide a section-by-section accounting of the findings of the inventory.

The following township reference numbers have been used:

Study Area 1

Township & Range	Township Number	Township & Range	Township Number
T27S, R8E	1	T29S, R9E	15
T27S, R7E	2	T29S, R10E	17
T27S, R9E	3	T29S, R11E	18
T27S, R9E	4	T29S, R12E	19
T27S, R10E	5	T30S, R7E	20
T27S, R11E	6	T30S, R8E	21
T27S, R12E	7	T30S, R9E	22
T28S, R7E	8	T30S, R10E	23
T28S, R8E	9	T30S, R11E	24
T28S, R9E	10	T30S, R12E	25
T28S, R10E	11	T31S, R7E	26
T28S, R11E	12	T31S, R8E	27
T28S, R12E	13	T31S, R9E	28
T28S, R7E	14	T32S, R7E	29
T28S, R8E	15		

Study Area 2

Township & Range	Township Number	Township & Range	Township Number
T21S, R5E	30	T24S, R5E	33
T22S, R5E	31	T25S, R5E	34
T23S, R5E	32	T26S, R5E	35

These township reference numbers appear on the topographic maps which accompany this report, on maps of the Study Areas 4 and 51, and on the distribution summary maps of each of the species. Do not confuse these township reference numbers with the Population Code numbers of the target taxa. By using the township reference number which appears in the upper right corner of each Township Finding Form, the "level of effort" and "findings" for any given area can be located easily.

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(to be provided final delivery of report copies)

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INTRODUCTION

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Background and Purpose

Sclerocactus wrightiae was officially listed as Endangered in 1978 under the Endangered Species Act (ESA) of 1973 as amended. The inventory of its habitat on Bureau of Land Management lands in the Richfield District was required by the rules and intent of that act, which is directed toward preservation of species which may be threatened by extinction in all or major portions of their ranges. In accord with declarations of Section 2 and of Section 7 of the ESA, which set forth procedures and requirements to be met by federal agencies in complying with the act, it is Bureau of Land Management policy to protect listed or candidate threatened or endangered plant and wildlife species. The Bureau, "through its actions and/or decisions in all planning and management activities, will ensure that actions authorized, funded, or carried out will not jeopardize, destroy, or adversely affect" the continued existence nor the essential habitat of listed species. "The objectives of all programs will include the means to conserve officially listed plants, to promote delisting, and/or to enhance or maintain the ecosystems occupied..." (BLM Washington Office Instruction Memorandum No. 80-722). The District Manager has been identified (BLM Washington Office Instruction Memorandum No. 81-130) as being responsible for carrying out inventories and contracting for studies to determine the presence or absence of sensitive and officially listed species on BLM administered lands.

To effectively implement these mandates and policies, the Bureau of Land Management must know where and in what numbers Sclerocactus wrightiae occurs, as well as its habitat parameters and the existence and/or nature of

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To effectively implement these mandates and policies, the Bureau of Land Management must know where and in what numbers *Sclerocactus wrightiae* occurs, as well as its habitat parameters and the existence and/or nature of

potentially adverse impacts to its habitat. Additionally, information is needed for other candidate or listed threatened or endangered plant species which inhabit the general area where Sclerocactus wrightiae grows. These include Pediocactus winkleri, Schoencrambe barnebyi, Sphaeralcea psoralaoides, and Townsendia aprica. Knowledge of the abundance, distribution, ecological requirements, threats, and taxonomic status of these taxa will aid in determination of appropriate management policy by the Bureau of Land Management as mandated by the Endangered Species Act.

Therefore, in order to assemble such data, the Richfield District Bureau of Land Management contracted for the inventory here reported of Sclerocactus wrightiae and associated sensitive species in portions of Sevier, Wayne, and Garfield counties (Contract No. UT-910-CT5-2685).

Project Area

The project area includes lands in the Sevier River and Henry Mountain Resource areas of the Richfield District Bureau of Land Management. It encompasses nearly 600,000 acres (over 900 square miles) and includes elevations from 4200 - 7600 feet. In Sevier County it includes a narrow band from the Emery County line on the east to higher elevation U.S. Forest Service land on the west. In Wayne County it encompasses the whole central part of the county, extending from the sandy deserts east of Hanksville westward to Capitol Reef National Park. Two contiguous townships in Garfield County, lying between Mt. Ellen of the Henry Mountains and Capitol Reef National Park, are also included. Figure 1 provides a regional perspective of the project area within Utah. Figures 2 and 3 show project boundaries related to local landmarks as well as township and range designations and township numbers which were assigned for inventory reference purpose.

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Project Area

The project area includes lands in the Sevier River and Henry Mountain Resource areas of the Richfield District Bureau of Land Management. It encompasses nearly 800,000 acres (over 900 square miles) and includes elevations from 4500 - 7800 feet. In Sevier County it includes a narrow band from the Emery County line on the east to higher elevation U.S. Forest Service land on the west. In Wayne County it encompasses the whole central part of the county, extending from the sandy deserts east of Hanksville westward to Capitol Reef National Park. Two contiguous townships in Garfield County, lying between Mt. Ellen of the Henry Mountains and Capitol Reef National Park, are also included. Figure 1 provides a regional perspective of the project area within Utah. Figures 2 and 3 show project boundaries related to local landmarks as well as township and range designations and township numbers which were assigned for inventory reference purposes.

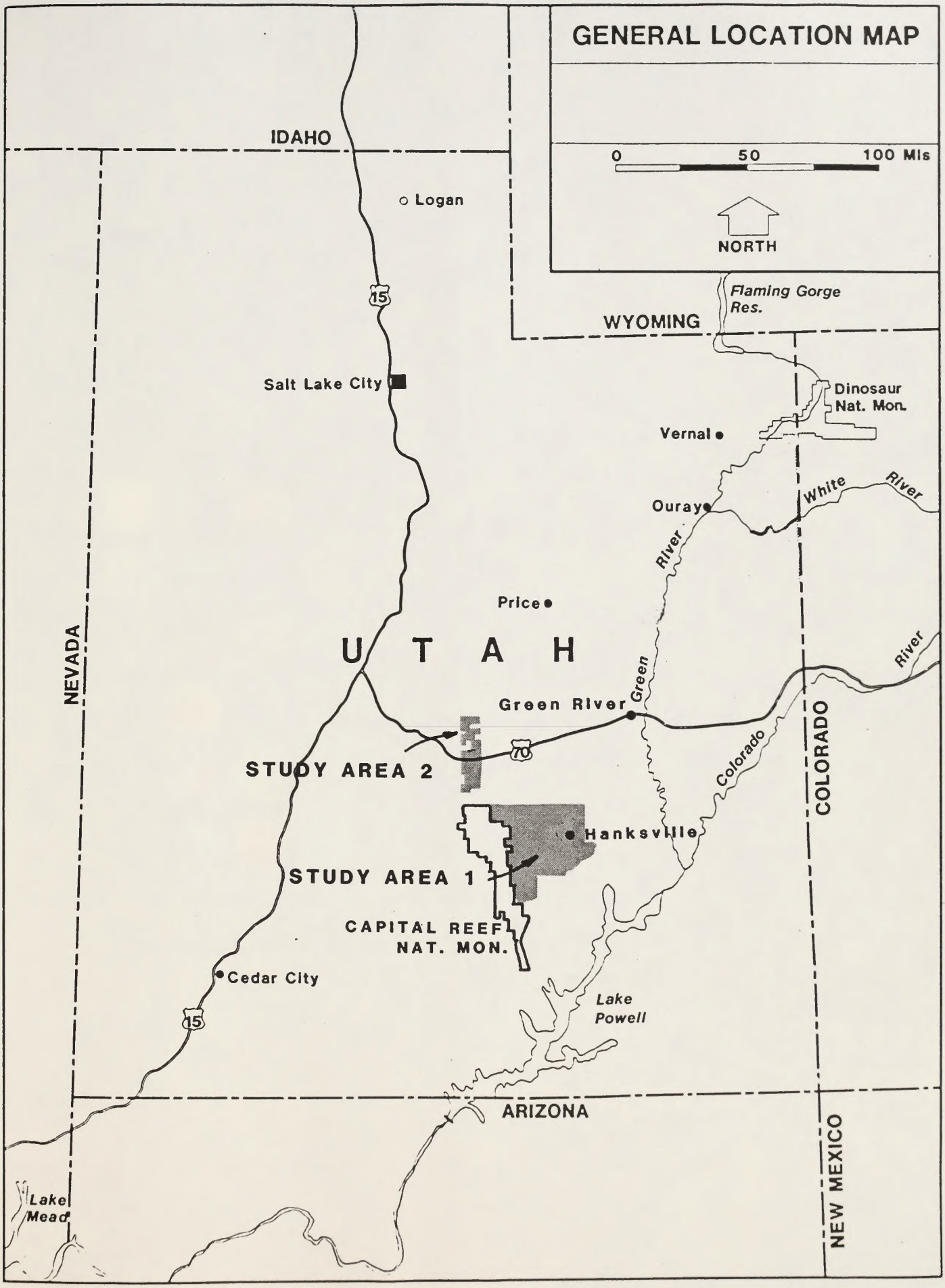

Figure 1. General Location of the Study Areas.

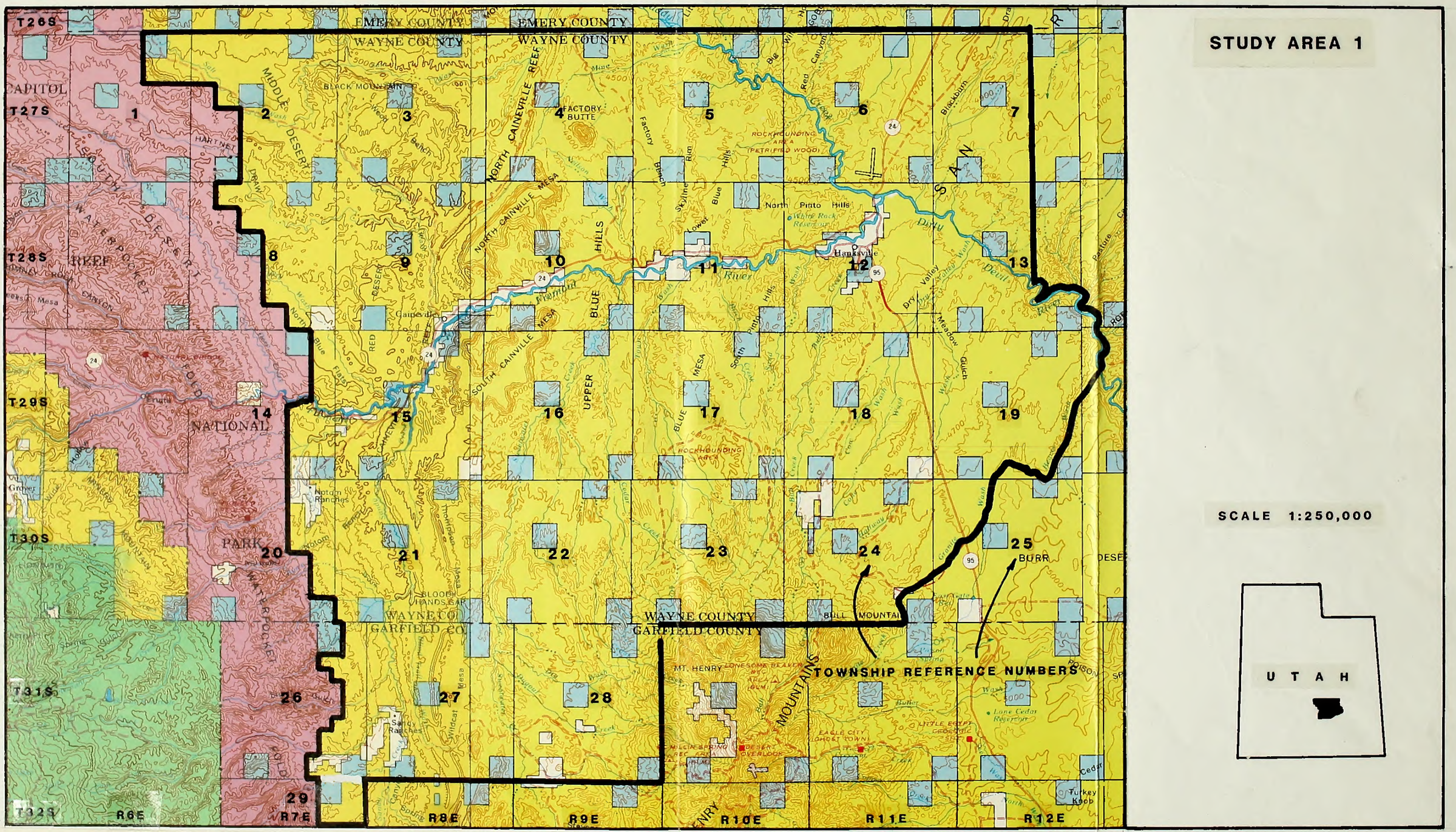

Figure 2. Study Area 1.

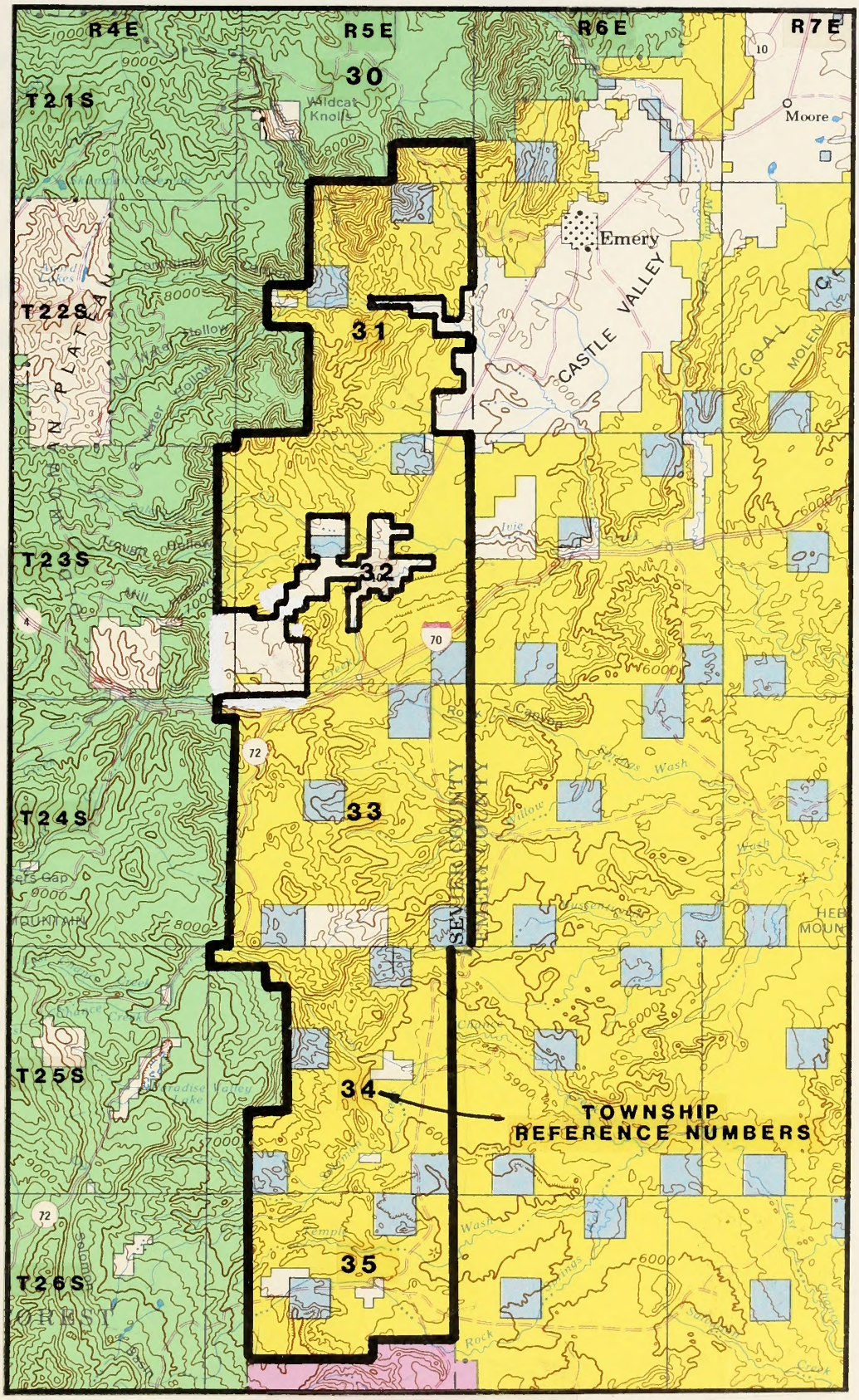

Figure 3. Study Area 2.

The project area encompasses most of the distribution of Sclerocactus wrightiae. Its distribution extends for a short distance beyond the project area into Capitol Reef National Park and into the Moab BLM District in Emery County.

Literature Review

Field work performed during the inventory was designed and conducted based on the body of information already known about Sclerocactus wrightiae and the four associated taxa of concern. That information, assembled through comprehensive literature and herbarium review, was previously provided as part of this contract in a preliminary report to the Richfield District Office in February, 1986. It is incorporated in the present document. For each of the five taxa of concern the following information has been provided:

Common Name
Original Citation
Synonyms
Taxonomic Discussion
Description
Known Distribution (previous to this study)
Habitat characteristics
Status
Guide to Subject Matter Contained in the Bibliography
Herbarium Specimen Label Data (through 1985)
Comprehensive Bibliography of Pertinent Literature

The project area encompasses most of the distribution of Sclerocactus wrightiae. Its distribution extends for a short distance beyond the project area into Capitol Reef National Park and into the Moab BLM District in Emery County.

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Comprehensive Bibliography of Pertinent Literature

METHODS AND PROCEDURES

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Project personnel include Dr. Elizabeth Neese, project director and inventory team member; Frank (Buddy) Smith and Elizabeth Neely, inventory team members; Ronald Kass, field technician and data manager; and Jerry Hughes, cartographer. Jere Neese was responsible for computer programming and served as computer consultant. Christy Patton provided secretarial and technical support.

Before beginning field work, project personnel made a detailed and systematic search of all available information of the five taxa of concern. The following sources of information were utilized:

- original citations and descriptions of the taxa
- Utah Flora: Asteraceae, Malvaceae, Cactaceae, Brassicaceae (Great Basin Naturalist publications, 1978-1985); also draft manuscripts for the remaining families
- relevant floristic manuals and monographic treatments, including The Cactaceae of the U.S. and Canada by Lyman Benson
- rare plant survey reports
- U.S. Fish & Wildlife status reports, where available
- U.S. Fish & Wildlife Recovery Plan for Sclerocactus wrightiae
- botanists knowledgeable about the species and vegetation of the Hanksville area and specialists (Dr. S. L. Welsh, Dr. Arthur Cronquist, Dr. Duane Atwood, Sherel Goodrich, Ken Heil, Dr. Leila Shultz, etc.) and with BLM and U.S. Fish & Wildlife personnel.

In addition, a herbarium search of the three major Utah herbaria (those located at the University of Utah, Utah State University, and Brigham Young University) was made to insure that previously documented sites are known.

METHODS AND PROCEDURES

Prior to the beginning of the field inventory, the project director prepared or procured the required forms, maps, and supplies. Computer programs were developed to maximize efficiency and to standardize entry of population-habitat and survey data forms. In late March Dr. Neese visited the project area to inspect seasonal development of the vegetation and target taxa. Field housing was arranged by leasing a residence in Hanksville.

Reconnaissance of the project area was conducted immediately prior to beginning of field work. Project members visited populations of target taxa in both the northern and southern portions of the study area, reviewed identifying characteristics and reinforced "search-images" of target taxa, and committed freshly to memory the recognition and sequence of geologic strata. In company with Contracting Officer's Representative David Young, known populations of Sclerocactus wrightiae and Pediocactus winkleri were visited and inventoried. Mapping techniques were reviewed and refined, and standardized methods of data-recording were developed. After completion of reconnaissance, systematic inventory of the study areas was begun. For the most part, each member of the inventory team worked independently although frequently traveling together to the particular area being inventoried.

The area included in this study is far too large to allow total census, given time and funding constaints. Therefore, in order to assemble the greatest amount of information in the shortest amount of time, field search focused on areas deemed of highest probabilty for the occurrence of Sclerocactus wrightiae. Habitat requirements and "search image" features are discussed on page 45 and 46. After initial reconnaissance efforts, little time was spent in areas of low probabilty (i.e., floodplains, steep slopes, sand dunes, and at higher elevations).

In accord with collaborative discussion with BLM personnel, relatively small amounts of time were devoted to detailed census once a population was documented. Rather, effort was devoted to visiting, as nearly as possible, all areas of potential habitat.

During the search for occurrence of Sclerocactus wrightiae, crew members were constantly alert for habitat types which might support others of the target taxa. At each occurrence located of any of the target taxa, photographs of the plant in its habitat accompanied by an identifying chalkboard were taken, and population and habitat data were recorded. These data, in respect to spatial area of population, number of individuals, and viability of population, are often subjective estimates. Precise data is usually given for location, habitat, and general abundance of the target taxa. Soil mapping units are not provided. (See note in Appendix at beginning of Population-Habitat section). Those data sheets are included in Volume II of this report, while pictures of the plant in its habitat at each population are included in this Volume I under the appropriate species discussion. At sites where the cactus' habitat was well differentiated from surrounding habitat, presumed population limits (potential habitat) were delimited on field maps and are indicated by dashed lines on the topographic maps accompanying this report.

In order to document negative as well as positive findings, and to insure systematic coverage of all parts of the study areas, survey forms ("Township Finding Forms") were completed daily for each geographic area searched. Data recorded on those forms include sections searched, general description of the area, description of the nature and intensity of the search, and whether or not any of the target taxa were found. These forms, which are included in Volume II, are cross-referenced to relevant maps, population-habitat forms, and photographs of the target taxa. In addition,

positive findings have been highlighted by using **BOLD** and underline for the target species name and the sections where found. This allows quick location within the form of the critical aspect of the report. To avoid confusion, other Latin names are not underlined.

A voucher collection was made from each population of target taxa as specified by contract specifications and terms of U.S.F.W.S. collecting permits. Additionally, general botanical collections were made in order to contribute to knowledge of the diversity and distribution of the Utah flora.

At the end of each day's field work, crew members plotted the day's progress on a master set of maps, ran soil pH tests (soil samples were taken at the site of each occurrence), pressed plant specimens, and deposited exposed film and completed data sheets with the data manager, who subsequently mailed the film for developing and entered the data sheets on a portable computer.

Following completion of field work the inventory crew independently identified their own collections, using the most current manuals available and herbarium reference material. Computer entry of collections, and printing of labels for specimens and duplicates, was accomplished using a software program customized by Jere Neese. Photographic slides were indexed followed by selection of those deemed best for inclusion in this report. Glossy finish prints were prepared by The Camera Den, using Kodak paper. An additional set of slides has been selected, to be delivered upon acceptance of this final report, which document additional occurrences of the target taxa within populations and will supplement slides of which report prints were made.

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FINDINGS

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Introduction and a Description of Floristic Relationships and Elements

The study areas lie in the Canyonland floristic section of the Intermountain region (Holmgren 1972) and are characterized by temperature extremes and aridity (Hunt 1953). Study Area 1 (Figure 2), which is far larger than the more northerly Study Area 2, has an average annual range in temperature at Hanksville of 138 F (approximately -26 to 112 F), while annual precipitation is about 5 to 8 inches (Neese 1981). The land is sparsely vegetated, and consists principally of badlands and mesas in the central portion bordered by sand deserts on the east, hogback ridges to the west, and pediment gravel benches on the footslopes of the Henry Mountains to the south. Study Area 2 (Figure 3) exhibits similar landforms but temperature extremes are usually less and rainfall somewhat greater. Sparsely vegetated, usually saline, badlands predominate in the east portion of Study Area 2. The western side comprises the eastern footslopes and cliff systems of the Fishlake and Old Woman Plateaus. Both of the study areas lie in the rainshadow of high plateaus to the west. The lowest elevations within the study area are in the drainages near the Dirty Devil River (about 4200 ft), while the highest is the summit of Table Mountain (8521 ft).

The land is largely unsettled except along floodplains of the principal watercourses, and for the most part is not commercially or industrially developed. Coal, uranium, and bentonite resources are present and are the cause of some exploratory and development activities.

Geology

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Geology

Geologic substrates are controlling, both in development of the landforms and of the vegetation of the study areas. Differential erosion of the

alternating hard and soft rock strata has resulted in a distinctive topography of stairstep-like flats or mesas and steep slopes and cliffs, and in steep hogback ridges with intervening strike valleys. Resulting soils are sharply differentiated in regard to texture and chemistry. An understanding of this pattern of alternating coarse and fine rock strata and resulting topographic regime is essential to interpretation of the distribution of Sclerocactus wrightiae.

The badlands and mesas of the central part of Study Area 1, extending from the Caineville Reef and Waterpocket fold on the west to the vicinity of Hanksville, are a result of such differential erosion acting on alternating strata of resistant sandstones and easily eroded clay, silt, and mudstones. Figures 4 and 5 show generalized geologic maps of Study Areas 1 and 2. It is on gentle slopes near the contact zone of the various strata, especially the Curtis, that Sclerocactus wrightiae is most abundant.

The resistant strata (starting with the youngest) include the Mesa Verde, Emery, and Ferron sandstones (Figures 6 and 7 - these sandstone strata are not differentiated in Figures 4 and 5), the Dakota Formation (Figure 8), the Salt Wash member of the Morrison Formation (Figures 6, 9, and 10), and the Curtis Formation (Figures 10 and 11). These strata form capstones which hold up the principal mesas such as North and South Caineville Mesa, Factory Butte, Skyline Rim, Big Wildhorse Mesa, Thompson Mesa, the Pinto Hills, and Penitentiary Point. At the higher elevations, uniform juniper or pinyon-juniper communities develop on rimrock or on shallow soils overlying sandstone bedrock.

Intervening easily-eroded strata form steep clay barrens and poorly drained saline benches which support salt desert shrub communities. These latter strata include the Masuk, Blue Gate, and Tununk members of the Mancos Shale Formation (Figures 6 and 7), the Brushy Basin of the Morrison Form-

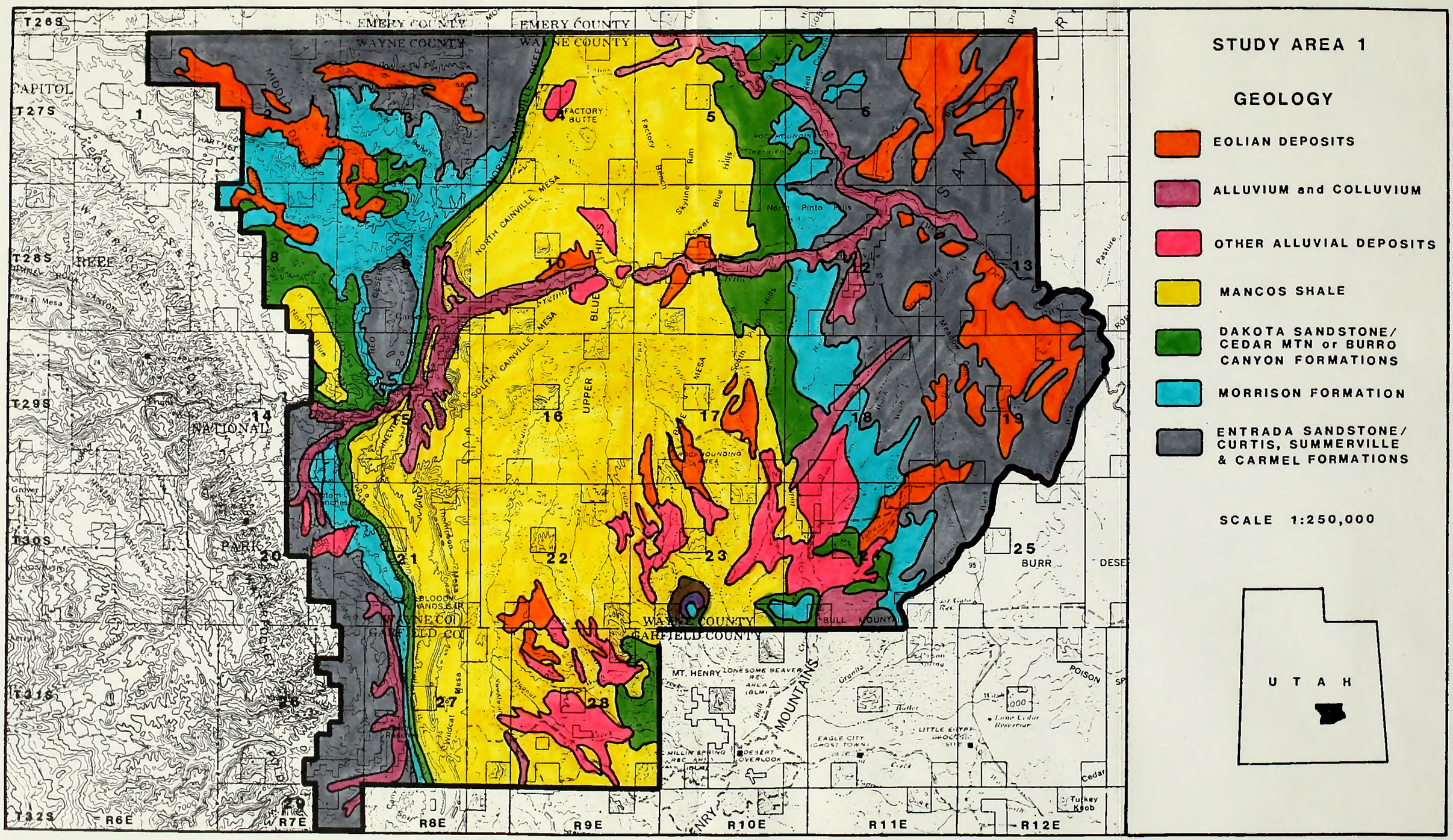
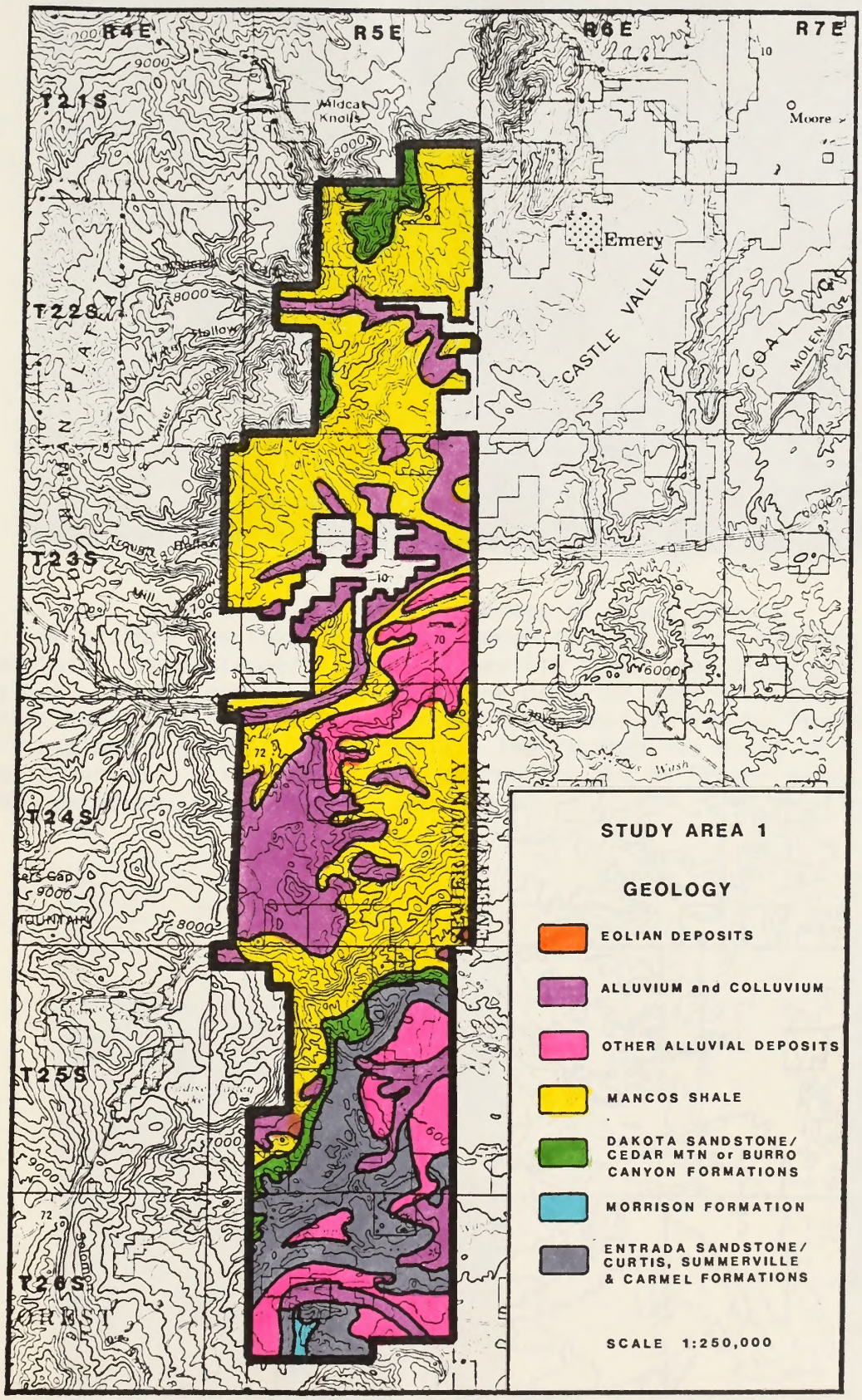


Figure 4. Geologic Strata of Study Area 1



STUDY AREA 2
SCALE 1:250,000

Figure 5. Geologic Strata of Study Area 2

Figure 6. Geologic sequences of Study Area 1.
The picture was taken from Wood Bench looking toward the Henry Mountains (in distance). North Caineville Mesa looms prominently on the skyline. Cliff-forming Emery Sandstone caps the soft gray Blue Gate Shale slopes. North Caineville Reef (center), capped with Ferron Sandstone, shows dark badland slopes of Tununk Shale. The rounded low hills of alternating red-brown and white strata (lower center) are of Brushy Basin mudstones. The benchland (foreground) is held up by resistant Salt Wash sandstones.

Figure 7. Slope-forming Tununk Shale, capped with Ferron Sandstone.
The picture was taken from Skyline Rim looking toward the Henry Mtns.

Figure 8. Pale mound-forming mudstones of the Brushy Basin member of the Morrison Formation (middle left) capped (center skyline) with resistant strata of the Dakota Formation. Such gravelly, juniper-dotted benches shown in the lower right quarter of the picture are prime sites for Pediocactus winkleri. The picture (which should read 29S, not 30S) was taken about two miles northeast of Notom looking northward.

Figure 9. Brushy Basin strata forming characteristic colorfully-striated, rounded hills. The pale sandstone at the base is the Salt Wash member of the Morrison. Sclerocactus wrightiae is predictably present but usually not abundant in shallow, sandy, gravel-covered pockets in such habitat. The picture was taken in the Wood Bench area.

Figure 10. Penitentiary Point, about seven miles south southeast of Hanksville. Sandstone of the Salt Wash member of the Morrison Formation caps the softer reddish Summerville strata. The pale-colored benchland in the foreground and at the base of the Summerville is the Curtis Formation. It is on the Curtis that Sclerocactus wrightiae is usually most abundant.

Figure 11. Whitish benchland derived from the Curtis Formation, with reddish Summerville strata in the center and right background. The picture was taken near Hanksville.

ation (Figures 6, 8, and 9), and the Summerville Formation (Figures 10 and 11.) The sand desert communities at the east margin of the study areas are developed principally on sand derived from the Entrada Sandstone (Figure 48). The hogbacks of the western part of the study area are a result of removal by erosion of softer strata and truncation of the harder strata that were tilted by the San Rafael and Monument upwarps.

Study Area 2 (Figure 3), consists of a north-south trending strip of land about six miles wide and 36 miles long. The landforms are derived from strata of essentially the same geologic sequence as those of Study Area 1, but a far larger proportion of the area consists of the clays and sandstones of Mancos Shale and the Mesa Verde group (Figure 5). In only the southern fourth of the area is there the diversity of geologic strata in close proximity that characterizes Study Area 1.

Vegetation

The geographic location of the study areas is such that the vegetatiom is influenced by proximity to floras of the Wasatch, Utah and Colorado plateaus, the Mojave, Great Basin, and Navajo deserts, and to a lesser degree, the mountains of the Wasatch, southern Rocky, and Great Basin ranges. Thus, many species which inhabit the area are near the margin of their range. The geologic substrates are controlling in development of the vegetation of the study areas, and although few species are strictly limited to particular strata, development of vegetative types is closely tied to soil texture, depth, and water and ion relations, especially as regards the target taxa. The plant communities are closely correlated with the physiographic features of the area, which are in turn the result of the differential weathering and erosion of the different substrates.

Physiographic areas of the study area, each of which develop a

characteristic vegetative type, include as discussed above badlands and mesas, gravel benches, hogback ridges, and sand deserts. The mesa summits usually support uniform juniper communities on the shallow soils that overlie sandstone bedrock. On steep clay barrens and poorly drained saline flats of the badlands grow salt desert shrub communities. Shadscale or another of the salt bushes such as mat atriplex or Castle Valley saltbush is characteristically the principal dominant.

Gravel benches, best developed on abandoned terraces near the Fremont River, on the footslopes of the Henry Mountains, and on fans and toe slopes of benches and clay cliffs, are usually better drained and less saline. Mixed desert shrub communities replace the salt desert shrub vegetation in such areas. The communities generally consist of several codominants including several of the following: shadscale, little rabbitbrush, matchweed (Gutierrezia), several sagebrush species, horsebrush (Tetradymia), and grasses including Agropyron, Stipa, Oryzopsis, Bouteloua, and Sitanion. Several species of cactus including Coryphantha vivipara (Figure 12), a Sclerocactus and Pediocactus look-alike, occur in this

Figure 12. Coryphantha vivipara
Note the short, non-hooked central spines and the sharply pointed and fringed petals.

vegetative type. Where the gravels are fine and the soils have a clay component from closely adjacent saline and gypsiferous shales, it is in the mixed desert shrub communities (and less abundantly in the closely adjacent salt desert shrub communities) that populations of Sclerocactus wrightiae characteristically occur.

The sand deserts usually occupy the lowest and warmest parts of the study area. Blackbrush (Coleogyne), Mormon tea (Ephedra), Eriogonum leptocladon, purple sage (Poliomintha), sand sagebrush (Artemisia filifolia), and yucca (Yucca angustissima) indicate affinities with more southern floras. None of the target taxa occur with regularity on this vegetative type. However, the narrowly endemic (Category 3C) Asclepias ruthiae grows here.

Several kinds of cacti grow in the study area, some of which are superficially similar to the rare species searched for during this inventory. However, differences are easily detected when one knows what to look for. Species which occur in the study area are currently included within five genera: Opuntia (four species), Echinocereus (two species), Coryphantha (one species), Sclerocactus (two species), and Pediocactus (two species). The characters by which each of the genera and species of the study area may be distinguished follow, as well as photographs of each.

The hedgehog cacti (Echinocereus) have cylindrical ribbed stems which do not bear glochids in the areoles and are distinguished by the production of flower buds which arise from the side, not the apex, of the stem, rupturing the surface as they develop. Echinocereus engelmannii (Figure 13) has enormous purplish-pink flowers; the plants form few-stemmed small clumps. Echinocereus triglochidiatus (Figure 14) is our only red-flowered cactus. The plants form large mounds consisting of many stems.

The prickly pears (Opuntia) are easily distinguished from other cacti

Figure 13. Echinocereus engelmannii (purple torch hedgehog cactus). As with all Echinocereus, the flowers are borne at the side rather than at the apex of the stems. It is the largest flowered of all our cactus. The population on the benches at the northwestern base of Mt. Ellen represents the northernmost limits of this species.

Figure 14. Echinocereus triglochidiatus (scarlet hedgehog cactus). The red flowers and numerous clustered stems make this our most easily recognized cactus. It usually grows in rocky places in the pinyon-juniper zone.

by the presence of flattened pads or joints which have numerous tiny glochids in the areoles, with or without spines. Also, new growth has, for a brief time, rudimentary leaves. The four species of prickly pears (Opuntia) of the area, taken together, are the most abundant and "weedy" of the cactus group. They often increase in response to trampling and grazing, responding to increased soil moisture resulting from reduction in vegetation. In addition, joints are freely produced and root readily wherever they come in contact with the ground. The plants thus often form large sprawling clumps. Many individuals of prickly pears cannot be confidently assigned a specific name, perhaps due to the frequent development of populations of hybrid derivation. Many names have been applied to plants of the study area, based in part on spine length, texture, color, number, and shape; on size and shape of the joints; on degree of fleshiness of fruits; and on flower color. There is often little correlation of these features although populations are often locally uniform. Our plants are usually assigned to one of the four following species: Opuntia polyacantha (Figure 15, top), characterized by presence of terete spines and relatively large, flattened joints; O. erinacea (Figure 16, top), with basally flattened spines and large flattened joints; O. fragilis (Figure 15, bottom), with short terete spines and small sub-terete, easily detached joints; and O. basilaris (Figure 16, bottom), without spines in the areoles and with large flattened joints. Opuntia macrorhiza, which shares characters of the other species but has fleshy fruits and more strongly prostrate stems, may also occur in the area. The prickly pears make good rock garden subjects since they are floriferous, are easily established from the wild, grow rapidly, are not endangered nor threatened, and have spectacularly beautiful flowers (especially Opuntia basilaris var. heilii).

Figure 15. Yellowish flowered prickly pears of the Study Area.

The top picture is of Opuntia polyacantha. The flattened pads form sprawling clumps which are especially abundant in heavily grazed areas. This taxon interbreeds freely with Opuntia erinacea, and populations often show great variability in flower color and spine characteristics. The bottom picture, taken near McMillan Springs on Mt. Ellen, is a closeup of the flowers of Opuntia fragilis. The flowers and the pads, which are scarcely flattened, are much smaller than those of our other prickly pears. Intermediates between the two shown here sometimes occur.

Figure 16. Pink flowered prickly pears of the Study Area.

The top picture is of Opuntia erinacea. It is sometimes common on gravelly benches, and may intergrade with yellow flowered phases. The bottom picture, taken just east of Bert Avery Seep, is of a beavertail cactus, Opuntia basilaris var. heilii. It sometimes forms great colorful patches on clay badlands. It differs from other, more southern, varieties in its bright rosy-pink flowers rather than yellowish to light pink ones.

Both Pediocactus and Coryphantha have globose, unribbed stems with tubercles. The flowers are borne at the apex of the plant body. The tubercles of Coryphantha have a longitudinal groove that runs along the upper surface of the tubercle. C. vivipara (Figure 12) is a diminuitive, usually single-stemmed, little ball cactus with delicately fringed and sharply pointed petals. Pediocactus simpsonii (Figure 17) is usually a little larger and lacks the grooved tubercle and fringed and pointed petals. Pediocactus winkleri will be discussed in the following section.

In addition to Endangered Sclerocactus wrightiae, to be discussed in detail in the next section, another fish hook cactus grows in the study area. Sclerocactus whipplei var. roseus (Figures 18 and 19) occurs occasionally in the area, with a distribution that surrounds that of Wright's fish hook cactus. If our plants are recognized as specifically distinct from plants near the type locality of S. whipplei, the currently accepted

Figure 17. Pediocactus simpsonii (Simpson hedgehog cactus). This widely distributed relative of the rare Winkler pincushion cactus is sometimes abundant on rocky grassland benches in the mountains, especially on the Fishlake Plateau. It is much larger than Pediocactus winkleri and does not grow in the area where the Winkler cactus is known.

Figure 18. Sclerocactus whipplei var. roseus. This common relative of Wright's fishhook cactus has a wide distribution which surrounds that of Sclerocactus wrightiae. The two do not occupy the same habitat, but where their distributions meet, intermediates may occur.

Figure 19. Sclerocactus whipplei var. roseus (yellow flowered phase). This is the common color phase on the northwest side of the Henry Mountains. It seems to differ in no appreciable way other than flower color, but in the study area the two color phases have distinct distributions.

name is S. parviflorus. There are three poorly-marked phases of Sclerocactus whipplei var. roseus in the study area. Those plants south and east of the distribution of Wright's fish hook cactus are generally large and cylindrical, very spiny, and with pink-purple flowers (Figure 18). Those to the south and west are similar but have pale lemon yellow flowers (Figure 19). Those from Study Area 2 are usually smaller, more globose, and with pink-purple flowers. Where populations of S. whipplei var. roseus grow in close proximity to Sclerocactus wrightiae, intermediates are common.

Several species which occur in the study area beside the five target taxa are narrowly endemic or rare. Those which are included on the Federal Register review list (Fed. Reg. 1985) include Asclepias ruthiae, A. subcinereus var. basalticus (Figure 20), Astragalus barnebyi (Figures 21 and 22), A. pardalinus, A. woodruffii, Castilleja scabrida, Chamaechaenactis scaposa

Figure 20. Astragalus subcinereus var. basalticus.
This variety, which is a Category 2 Candidate for listing as threatened or endangered, is endemic to western Emery and nearby Sevier counties, Utah. It is distinguished from the typical variety by possession of substantially smaller pods and larger flowers, and is locally common in Study Area 2.

Figures 21 and 22. Astragalus barnebyi.
The upper picture shows the plant habit, the lower a closeup of the flowers and fruit. This is a category 3C plant which occurs on shallow sandy soil top sandstone slickrock. It is very similar to the more widespread A. desperatus and is sometimes treated at varietal level within that taxon. However, the flowers are larger and the pods less densely silky.

Cryptantha creutzfeldtii, Euphorbia nephradenia, and Peteria thompsoniae. Of these, only Astragalus subcinereus var. basalticus (Category 2) remains a candidate for Threatened or Endangered status; the others have been reduced to Category 3C. Species which are known from nearby areas and which may eventually be found in the area include A. harrisonii (Category 2), Cycladenia humilis (Proposed, Endangered), Erigeron maguirei var. harrisonii (Category 2), and Eriogonum cronquistii (Category 2).

During inventory efforts in Study Area 2, Frank Smith collected a species of Gilia which proves to be unnamed. Additional material was collected by Dr. Neese in August. The material has been examined not only by inventory personnel, but by Dr. Leila Shultz, Dr. Arthur Cronquist, and Dr. Stanley Welsh. It is a distinctive taxon with closest affinities apparently with Gilia caespitosa. Formal description of the new species awaits the collection of good type material and fruiting material.

Discussion of the Target Taxa, Their Endemic Centers and Critical Habitat

PEDIOCACTUS WINKLERI Heil (Figures 23-31)

Common Name: Winkler's pincushion cactus

Status: Proposed Endangered

Original Citation: Heil, Kenneth D. 1979. Three new species of Cactaceae from southeastern Utah. Cactus and Succulent Journal (U.S.) 51: 25-30.

Synonyms: None

Taxonomic Discussion: Pediocactus winkleri is closely related to Pediocactus despainii Welsh, another small pincushion cactus of exceedingly narrow distribution that occurs at higher elevation and in a different edaphic situation in the San Rafael Swell. It may be separated from that species, inter alia, by the presence of wooly (not villous) areoles and smaller seeds. The two taxa are allopatric. Most species in the genus Pediocactus follow a similar pattern of narrow endemism and specialization for peculiar edaphic regimes.

Description: Plants (Figure 24-26) mostly solitary, ball-shaped, 1-2 inches tall, tubercled; areole white-wooly (the wool most abundant in juvenile individuals (Figure 26), without central spines, the 8-14 radial spines white, spreading, about 1/8 inch long; flowers (Figure 24), borne at the apex of the plant near the top of the areole, reddish-brown in bud, pale yellowish peach when fully open, the outer perianth parts brown-tinged, a cluster of golden yellow stamens borne at the center of the flower; fruit (Figure 25) protruding above the spines, smooth, top-shaped, initially green, reddish brown at maturity, the wall thin, splitting at maturity by a dorsal slit; seeds 1/8 of an inch or less long, irregularly papillate, black.

Known Distribution: Herbarium specimens document the occurrence of the

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Known Distribution: Herbarium specimens document the occurrence of the

Winkler's pincushion cactus from near Notom, Utah, in the following three townships: T29S, R7E; T29S, R8E; and T30S, R7E. It is reported by Ken Heil to occur also in T28S, R7E (about 7 miles north-northwest of Utah Highway 24), and in Capitol Reef National Monument in T27S near the boundary of Ranges 5 and 6E. Mr. Heil also reports that John Anderson of the U.S. Fish and Wildlife Service may have found it near I-70 in the vicinity of the freeway and its junction with Utah Highway 72 or 10. That report is tenative until documented. Additional information about occurrences of Winkler's pincushion cactus has been assembled during vegetative inventory of Capitol Reef National Monument during the 1986 season (Heil pers.comm.).

Early location data for collections of this plant have been sometimes inaccurate, since topographic maps in general use do not coincide with modern road placement. Also, conservation-oriented field workers have tended to refrain from collecting vouchers of this extremely rare taxon, and to record only sketchy location data as to its whereabouts.

Habitat Characteristics: Winkler's pincushion cactus grows in desert shrub communities where soil has a silt or clay component; atriplex species are usually present. The cactus favors the Dakota Formation, following it from the Notom area into Capitol Reef National Monument (Heil, pers. comm.).

Inventory Findings: Twelve occurrences of Pediocactus winkleri in nine sections, representing five populations, are here reported. Figure 23 shows the currently known distribution of Pedioacactus winkleri in Study Area 1. The species was not found in Study Area 2. Figure 88 itemizes the sections from which it is known. See Volume II for population-habitat data and for the Township Finding forms which detail inventory effort.

The most northerly of the reported populations occurs in the Hartnet Draw vicinity (Figure 27), where isolated remnant mounds of Brushy Basin

mudstones, capped with resistant rocks of the Dakota Formation, occur. Wherever nearly level, pebbly, shallow soil occurs on the summit of such mounds, Pediocactus winkleri is to be sought. Individuals were found on three such sites in the Hartnet Draw vicinity, but more populations undoubtedly exist on similar sites in the area. At the time of discovery of these populations the plants were past flowering, semi-buried, and extremely difficult to find. Additional inventory should be conducted in late April to accurately evaluate the number of populations and individuals.

Photographs of each of the reported populations (Figures 27-31) show the characteristic habitat of pebbly soil which supports widely scattered juniper, mixed desert shrubs, and grass. All populations known by me grow in small, usually recognizable pockets in such habitat on Dakota-remnant strata. Figure 8 shows that habitat particularly well. Although search efforts were not directed principally toward location of Winkler's cactus, our findings are such that future inventory effort for this very rare taxon can be conducted with high efficiency.

Herbarium specimen label data for Pediocactus winkleri, of previous collections and of collections taken during this inventory, are included in the appendix of Volume II.

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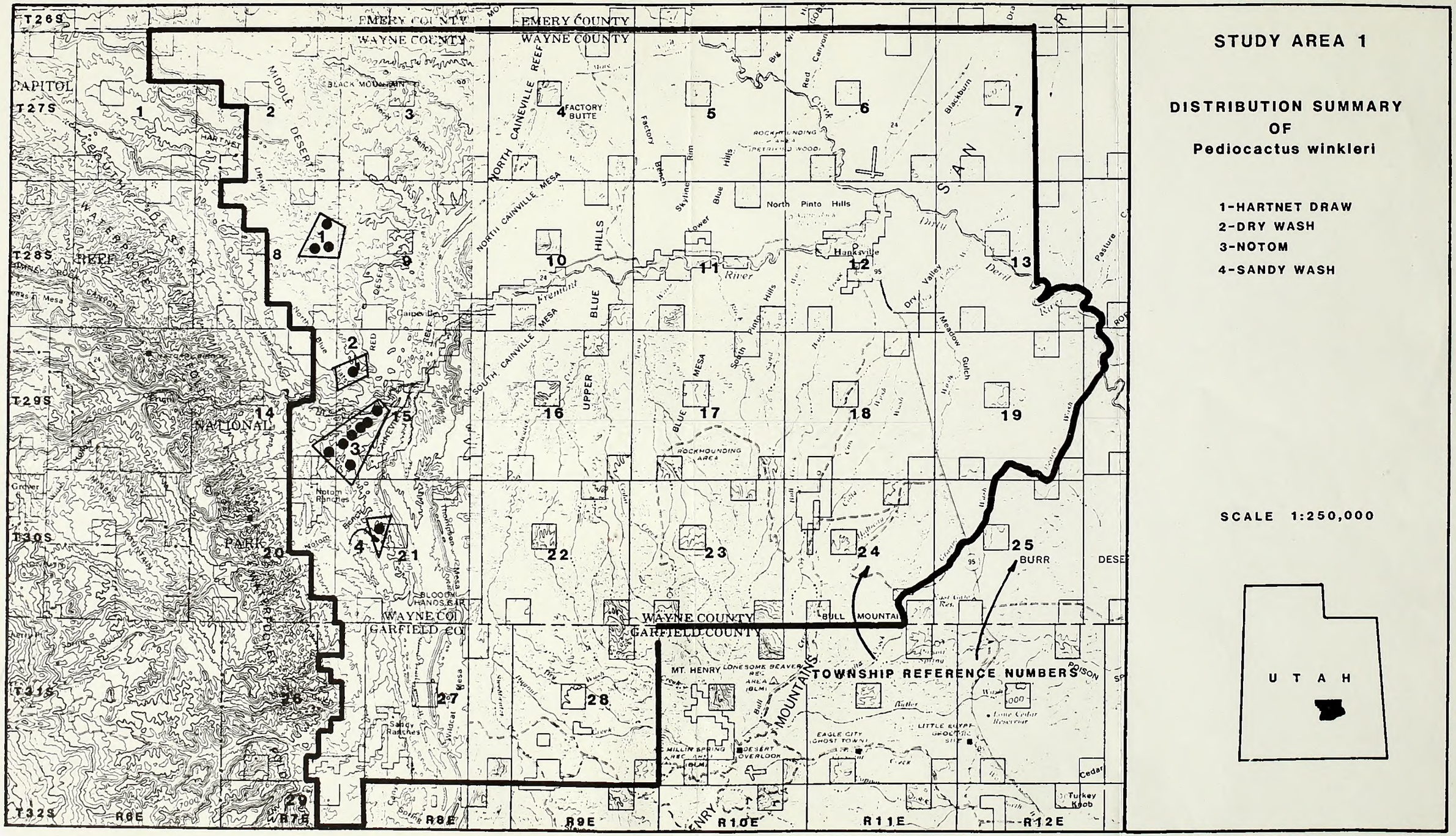

Figure 23. Distribution of Pediocactus winkleri in the Study Area.

Figure 24. Pediocactus winkleri (flowering)
Note the characteristic pale peach color of the flowers, the absence of central spines in the areoles, and the comblike (pectinate) radial spines. The flowers, which are about an inch long, are larger than the plant body in this average-sized mature individual.

Figure 25. Pediocactus winkleri (in fruit)
The turbinate fruits are dull purplish-black.

Figure 26. *Pediocactus winkleri* (vegetative)
The picture shows the distinctive, white-wooly areoles.
The presence of small gravels covering barren, fine-textured soil
seems to be a requirement for the occurrence of this cactus.

Figure 27. PEWI-1 Pediocactus winkleri at the Hartnet Draw population. The picture shows the general habitat. Remnants of the Dakota Formation cap the hill in the background. The cactus plant (in center foreground) is nearly invisible.

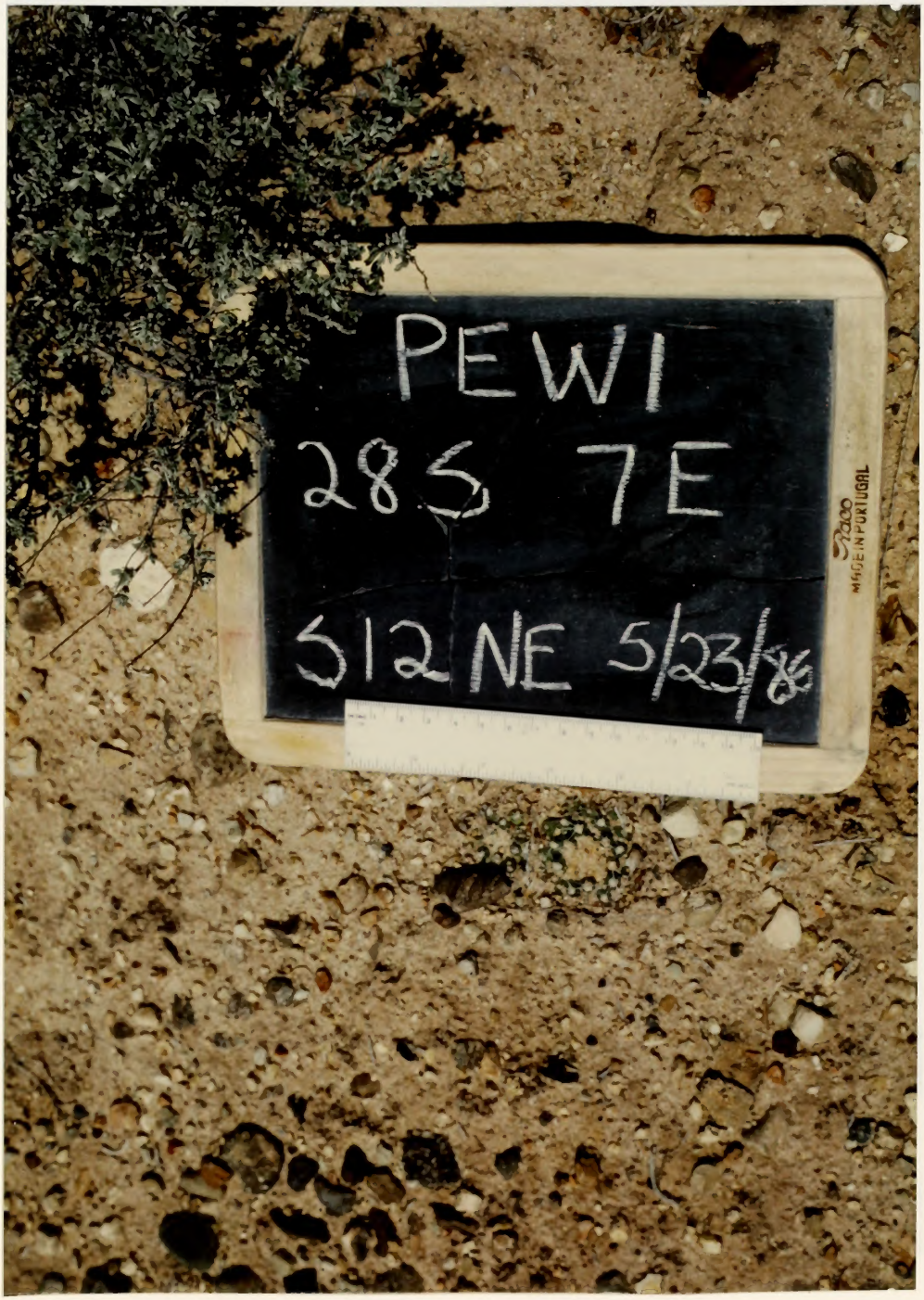

Figure 28. PEWI-1 Pediocactus winkleri at the Hartnet Draw population. This shows a closeup of the population pictured in the previous figure. Two plants, nearly buried in the substrate, are visible at the base of the white ruler.

Figure 29. PEWI-2 Pediocactus winkleri (left foreground) at the Dry Wash population. The nearly barren soil is much trampled by cattle which cross the population to water at Dry Creek.

Figure 30. PEWI-3 Pediocactus winkleri at the Notom population. Two individuals are shown in fruit on April 28.

Figure 31. PEWI-4 Pediocactus winkleri (upper left corner of the chalkboard) at the Sandy Wash population. The picture shows the sparsely-vegetated mixed desert shrub community characteristically favored by Pediocactus winkleri.

SCHOENCRAMBE BARNEBYI (Welsh & Atwood) Rollins (Figures 32-34)

Common Name: Barneby thelypody

Status: Federal candidate for threatened or endangered status, Category 1. The Utah Native Plant Society recommended in January of 1983 that the Barneby thelypody be considered Threatened. Welsh and Neese (1984) recommended that it be listed as Endangered.

Original Citation: Welsh, Stanley L. 1981. New taxa of western plants - in tribute. Brittonia 33. 294-303.

Synonyms: Thelypodiopsis barnebyi Welsh and Atwood

Taxonomic discussion: This species was first collected in flower by James G. Harris on June 3, 1980, from the base of Sy's Butte in the San Rafael Swell, Emery County, Utah. It was described (Welsh 1981) following additional collections showing both flowering and fruiting characteristics. The species was initially treated as a member of the genus Thelypodiopsis. Rollins (1982) transferred both T. argillaceae and T. barnebyi to the genus Schoencrambe, where they are included with S. linifolia (Nutt.) and S. linearifolia (Gray) Rollins to form a closely similar quartet. All have similar subwoody root crowns, similar arrangement and appearance of leaves, and similar inflorescences and fruits. The only one of these which grows near the Barneby thelypody is S. linifolia; it is easily distinguished from S. barnebyi by its taller stems and yellow, not purplish flowers.

Description: Plants blue-green, mainly 9-15 inches tall, from a woody root crown; leaves alternate, entire, about 1/2 to 2 inches long and 1/4 to 1 inch wide; flowers 2-8 in an elongate cluster; sepals 4, purplish green; petals 4, white to pinkish and prominently purple-veined, about 1/2 inch long; pods round in cross-section, 1 1/2 to 2 1/2 inches long, very slender. Figures 32 and 33 show the flowers and plant habit.

Known Distribution: The first collections of this briefly-known taxon were

taken in 1980. It is known only from the type locality at Sy's Butte, T26S, R9E, Sec.3, on the San Rafael Swell in Emery County, Utah. This location is about six miles north of the boundary of Study Area 1.

Habitat Characteristics: The Barneby thelypody grows on steep north-facing exposures of the Moenkopi Formation, where rock from the Wingate Sandstone and other strata forms talus slopes in the minor drainages. (Figure 34). The substrate is gypsiferous, calciferous, and seleniferous, as indicated by the presence of gypsum crystals in the soil and cementing matrix, and of selenium-indicating plants. The substrate is exposed in a series of barrens between widely spaced plants; in some areas there are no higher plants visible. The population is at an elevation of 5400 to 5750 feet.

Inventory Findings: Barneby's thelypody was not found during the study in either Study Area 1 or 2, nor does any Moenkopi Formation geologic strata occur in the areas inventoried. Although some of the Summerville strata topography near the south margin of the Moroni Slope superficially much resembles that of the Schoencrambe site, it is doubtful that the edaphic regime is suitable for the occurrence of this highly restricted taxon.

Figure 32. Schoencrambe barnebyi closeup. The flowers are about one-half inch long.

Figure 33. Schoencrambe barnebyi, plant habit. The leaves are thick, bluish green, and covered with a waxy film. The plant is in early flower.

Figure 34. Habitat of Schoencrambe barnebyi. The plants grow on red silty slopes near the bottom of steep gullies filled with talus blocks. The picture is of the northwest side of Sy's Butte, about six miles north of Study Area 1.

Herbarium specimen label data for Schoencrambe barnebyi are included in the appendix of Volume II. [ADDENDUM: Two additional populations of this poorly known taxon have been reported by Ken Heil (pers. comm.). During a vegetation inventory conducted during 1986 in Capitol Reef National Park, it was found along Sulfur Creek about two and one-half miles from its junction with the Fremont River. Although reported to be either from the Curtis or Chinle formations, geology maps of the area show a geologic sequence identical with that of the type locality, with no Curtis nor Chinle strata anywhere in the vicinity. Although this important find suggests that more populations will be found, I believe it is improbable that habitat for Schoencrambe barnebyi exists in Study Areas 1 or 2.

SCLEROCACTUS WRIGHTIAE L. Benson (Figures 35-69)

Common Name: Wright's fishhook cactus

Status: Endangered

Original Citation: Benson, Lyman 1966. A review of Sclerocactus. Cactus and Succulent Journal 38: 55

Synonyms: Pediocactus wrightiae (L. Benson) Arp

Taxonomic Discussion: Mrs. Dorde Wright Woodruff discovered Sclerocactus wrightiae in 1961 "near San Rafael Ridge" in Emery County. It was collected again by Irving G. Reimann in Wayne County ("Fremont River") in 1964, and by Lyman and Evelyn Benson in 1965. Lyman Benson named the cactus for its first discoverer in 1966. Wright's fishhook cactus is one of ten currently recognized members of the genus Sclerocactus in the desert southwest. Arp combined Sclerocactus with Pediocactus, recognizing Wright's fishhook cactus as Pediocactus wrightiae, but Welsh (1984) and Heil et al (1981) concur with Benson in segregation of Sclerocactus from Pediocactus. All workers concur in recognizing Wright's fishhook cactus at specific level, and it has been uniformly designated by the name Sclerocactus wrightiae in inventory and legislative documents.

The only other fishhook cactus growing in the near vicinity of Sclerocactus wrightiae is S. whipplei var. roseus (synonym, S. parviflorus) from which it may be distinguished by flowers which are whitish, cream, or light pink, not dark pink, purplish-pink, or yellow in color, and which do not open widely, thereby retaining a narrow, vase-like shape.

Description: Plants perennial; stems usually solitary and unbranched or rarely clustered (Figure 36), globose to short-cylindric, reported previously to this study to be 2-4 inches tall (we found occasional very old

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Description: Plants perennial; stems usually solitary and unbranched or rarely clustered (Figure 36), globose to short-cylindric, reported previously to this study to be 2-4 inches tall (we found occasional very old

individuals as much as a foot tall - see Figure 54); ribs about 13, tubercled, the tubercles more or less developed, the scar of the fruiting area occurring above the areole, vertically elongate; spines not obscuring the stem (contrast, for example the spininess of Sclerocactus wrightiae in Figures 36 and 40 with that of S. whipplei in Figures 18 and 19), the central ones 1-4 in number, usually darker than the radials (or white like the radials), the principal (lower) one usually hooked, mostly 1/3 to 1 inch long; radial spines white, 8-11 per areole, spreading, nearly straight, about 1/8 to 1/2 inch long; flowers 3/4 to 1/2 inch long, flowering beginning when plants very small (Figure 35); sepaloid perianth parts with pink, brown, or reddish midribs; petaloid parts white or tinged with pink or or creamy yellow, not widely spreading, the flower thus rather narrow and vase-shaped (Figure 40); fruit (Figure 41) ellipsoid, about 1/3 inch long; seeds black, tuberculate, less than 1/8 inch long (description modified from Welsh (1987), Benson 1966, 1982), and Mutz et al (1982).

Known Distribution: The occurrence of Sclerocactus wrightiae is documented by herbarium specimens from southwestern Emery County and closely adjacent Sevier County, and from central Wayne County. The area of known occurrence lies within a rectangular area approximately 50 miles long and 40 miles wide. Because there is an apparent tendency for occasional intergradation or hybridization of S. wrightiae and S. whipplei var. roseus where their ranges meet in southwestern Emery County near I-70, not all workers have concurred about the northern distributional limits of the Wright fishhook cactus. Further study is needed in that area to document the distribution and frequency of parental and intermediate types.

Habitat Characteristics: Sclerocactus wrightiae grows on semi-barren sites in salt desert shrub and mixed desert shrub communities. Dominant

species of the area where it grows are Atriplex cuneata, A. corrugata, Juniperus osteosperma, Hilaria jamesii, Artemisia bigelovii, and Gutierrezia sarothrae. Associated species include Indian ricegrass, Mormon tea, wild buckwheats, and prickly pears. It occurs between 4800 and 6200 feet elevation on several geologic formations. According to label data, it has been located on Morrison, Carmel, Entrada, Moenkopi, and Curtis formations, and on the Tununk, Ferron, Bluegate, and Emery members of the Mancos Shale Formation. Soils range from clays to sandy silts to fine sands. It is reported to grow in areas with well developed gypsum layers and in areas with little or no gypsum. Dr. Welsh notes that the habitat is almost always saline. Based on field observations during preparation of the Recovery Plan, Mutz et al (1982) report it to occur mostly where soils possess a surface structure with at least some cryptogramic crust. The sites are often littered with sandstone or basalt gravels and cobbles. The Wright fishhook cactus grows on flat to gently sloping areas with various aspect.

Inventory Findings: One-hundred and eighty occurrences of Sclerocactus wrightiae in 123 sections, these representing 27 populations, are here reported. Figure 37 shows the distribution of the cactus in Study Area 1; Figure 38 shows it in Study Area 2. Figures 88 and 89 itemize the sections from which it is now known. See Volume II for population-habitat data and for the Township Finding forms which detail inventory effort. Figure 39 illustrates the abundance of Wright's fish hook cactus relative to geologic strata, based on number of individuals observed during this inventory. Figures 40-42 show the plant in flowering, fruiting, and vegetative condition. Figures 43-69 document the cactus at each of the 27 populations.

As demonstrated in Figures 37 and 38, distribution of Wright's fishhook cactus in the study areas, especially in Study Area 1, is extensive.

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Figure 35. Sclerocactus wrightiae, Small Individual

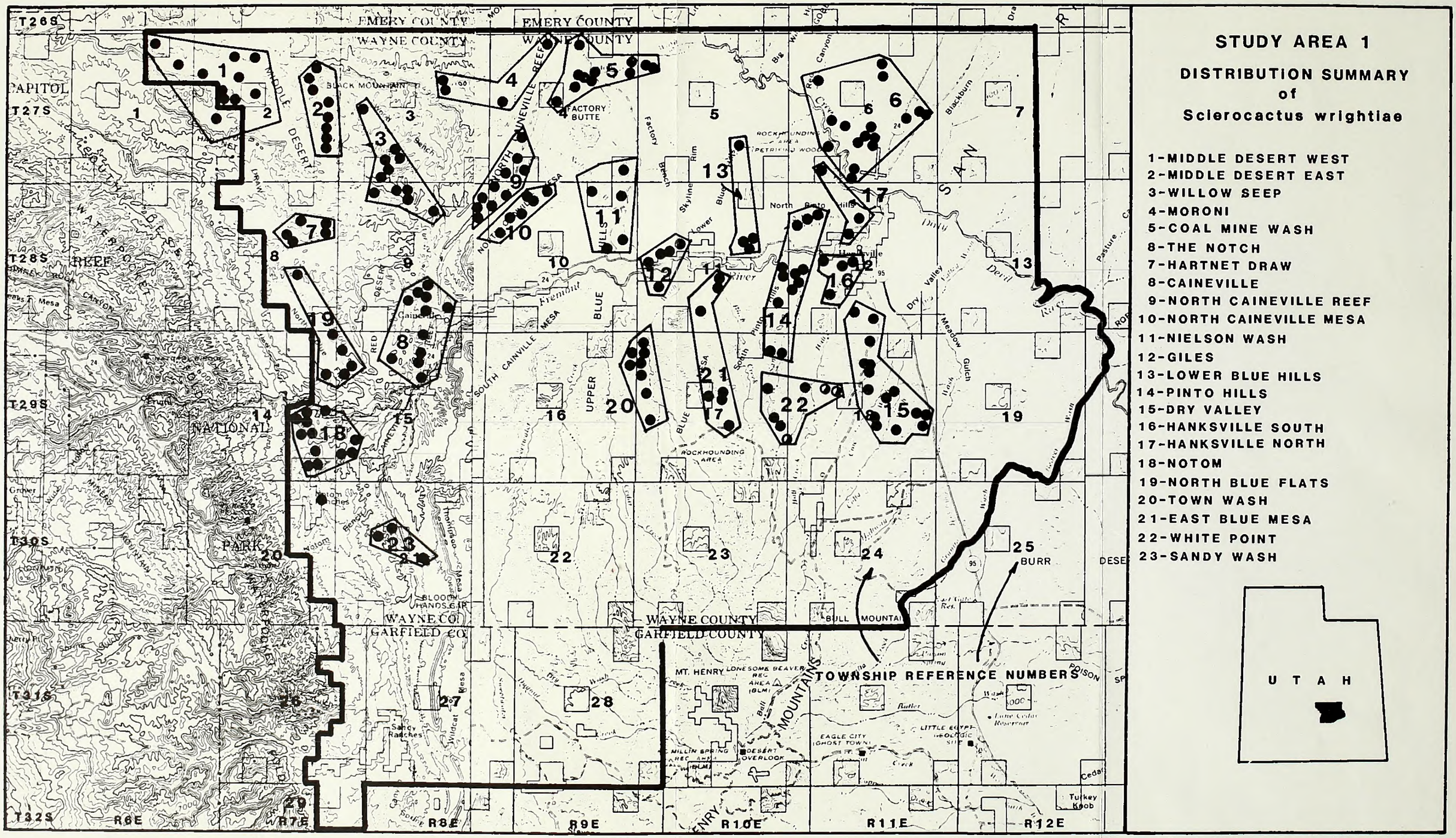
Figure 36. Sclerocactus wrightiae

Cluster of Large Stems

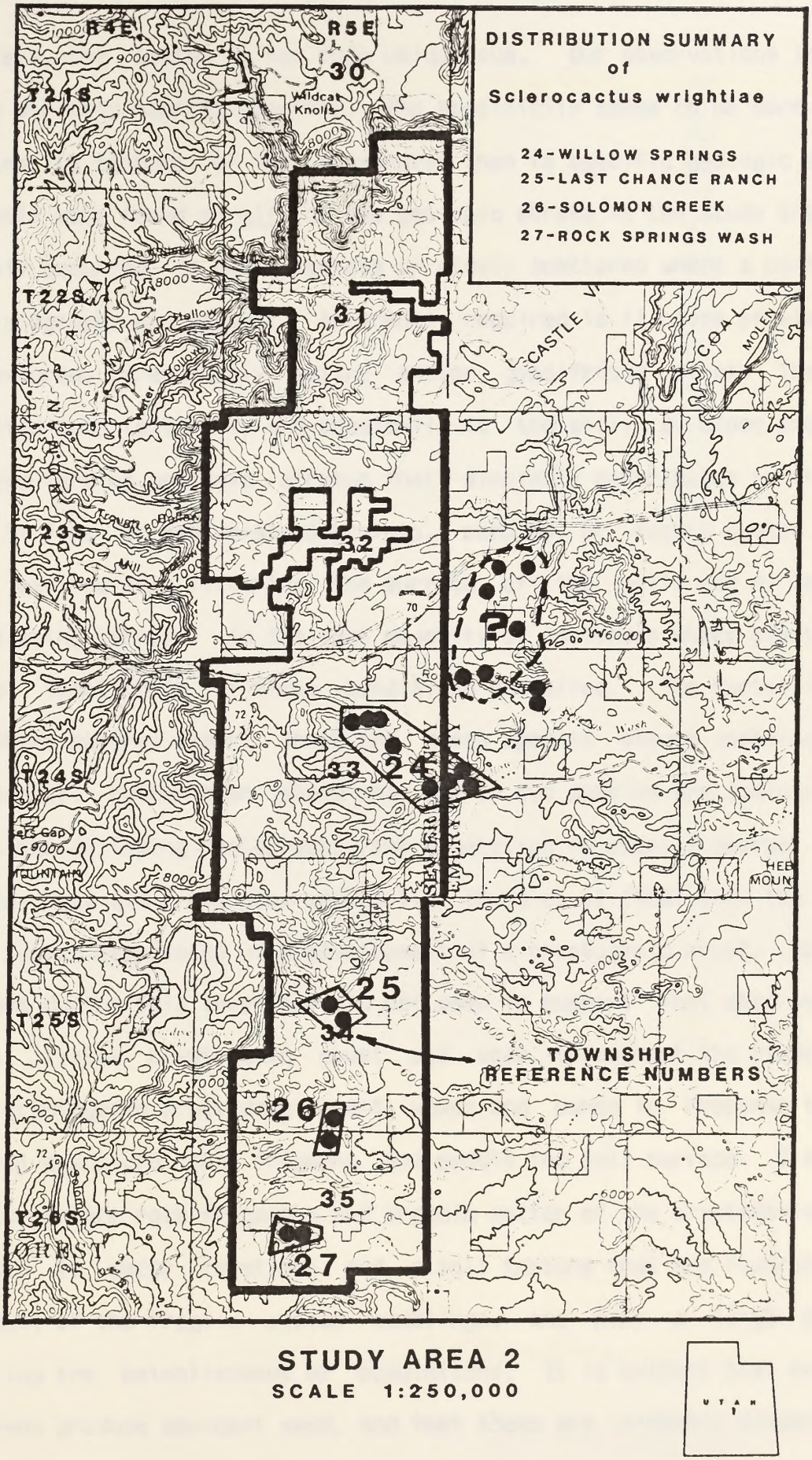
Figure 35. *Sclerocactus wrightiae*. Small Individual

Figure 36. *Sclerocactus wrightiae*

Cluster of Large Stems



37. Distribution of Sclerocactus wrightiae in Study Area 1.



STUDY AREA 2
SCALE 1:250,000

Figure 38. Distribution of Sclerocactus wrightiae in Study Area 2

Nonetheless, the cactus is far from ubiquitous. Our observations indicate it to be strictly habitat-specific. The specificity seems to be more closely related to texture of the substrates than to specific geologic strata. Individuals were found on all of the geologic strata in the study area, but invariably occurred in small pockets or widely scattered where a particular soil physiography was present. Apparently required is 1) close proximity to fine textured, presumeably saline and/or gypsiferous strata that have contributed both texturally and chemically to the soil; 2) close proximity to a sand-forming geologic stratum that similarly contributes to the substrate; 3) fine- or medium-sized gravels, pebbles, or fossil oyster shells in (and particularly littering the surface of) the soil; and 4) level to gently sloping terrain. In the vast majority of instances where plants were found, at least three of these conditions prevailed. The cactus is more common where several desert shrub and grass species assume codominance in the community, rather than where only one or two species are dominant. As shown in the following photographs, the vegetation is usually sparse.

Kathy Mutz and I had observed earlier (Mutz et al 1982) that the cactus usually seemed associated with development of a cryptogamic crust. Observations made during this inventory did not seem to support that observation - in fact, little cryptogamic crust was seen throughout the study area. Perhaps cryptogamic crust development waxes and wanes in response to rare torrential downpours that fragment and puddle the soil surface. I suspect that both surface rock fragments and organic matter of the cryptogamic crust contribute to water relations and a soil texture that are favorable for development of the fragile cactus seedlings, and play a large part in controlling the establishment of populations. It is evident that existing populations produce abundant seed, and that these are probably dispersed by sheet erosion. (Narrative continued on page 82)

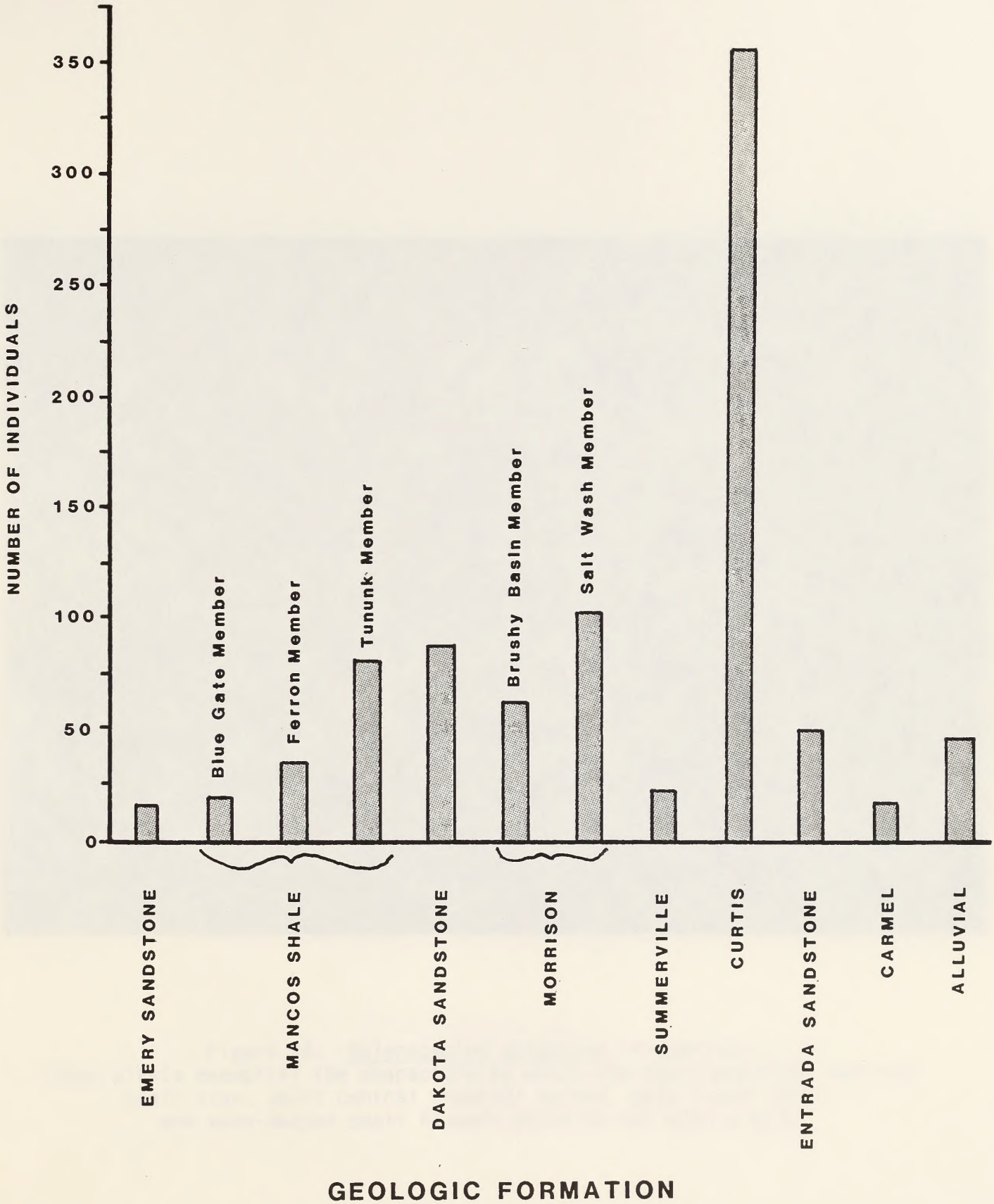


Figure 39. Abundance of Sclerocactus wrightiae Relative to Geologic Strata, Study Area 1.

Figure 40. Sclerocactus wrightiae (flowering).
These plants exemplify the characters by which the taxon was first defined:
small size, short central (hooked) spines, pale flower color,
and vase-shaped small flowers which do not open widely.

Figure 41. Sclerocactus wrightiae (in fruit).
The fruits are smooth and usually without persistent sepaloid scales. Note the single hooked central spine per areole.

Figure 42. Sclerocactus wrightiae (vegetative)
These are juvenile plants which have not reached blooming size.
Hooked centrals are not produced until the plant is several years old.
They are much darker than the radials, at least when young.
The lens cover at the right of the picture indicates the seedlings' size.

Figure 43. SCWR-1 Sclerocactus wrightiae at the Middle Desert West population. The picture is taken at occurrence SCWR-1C, looking toward Black Mountain.

Figure 44. SCWR-2 Sclerocactus wrightiae at the Middle Desert East population. The picture was taken about two miles south of Black Mountain, at the base of the Summerville Formation on a narrow bench of Curtis strata. The soil is characteristically barren.

Figure 45. SCWR-3 Sclerocactus wrightiae at the Willow Seep population. The picture was taken at the SCWR-3B occurrence, in shallow sandy soil on Salt Wash sandstone. Mudstones of the Brushy Basin member of the Dakota Formation (the hills in the background) have contributed to the soil.

Figure 46. SCWR-4 Sclerocactus wrightiae at the Moroni population. The blackboard is mislabeled, and should read "S4, SW of NW" not "S8 NWNE". Notice the the characteristic gravelly surface of the soil. The southern base of the Moroni Slopes is in the background.

Figure 47. SCWR-5 Sclerocactus wrightiae at the Coal Mine Wash population.
The site is three miles north northwest of Factory Butte;
The Henry Mountains are in the background.

Figure 48. SCWR-6 Sclerocactus wrightiae at the Notch population. The plant is growing at the base of Entrada sandstone. Populations are rarely found on Entrada sands unless, as here, the soil is surfaced with gravel which has been contributed by the overlying Curtis Formation. Curtis remnants may be seen as the lighter colored rock at the summit of the Entrada cliffs.

Figure 49. SCWR-7 Sclerocactus wrightiae at the Hartnet Draw population. The picture is taken at the SCWR-7B occurrence in Cathedral Valley. It is growing on gravelly surfaced shallow loamy sand.

Figure 50. SCWR-8 Sclerocactus wrightiae at the Caineville population. At this location, occurrence 8A, the plants were unusually large. They occur at the outwash of toe-slopes of Brushy Basin strata. The view is to the northeast and North Caineville Reef.

Figure 51. SCWR-9 Sclerocactus wrightiae at the North Caineville Reef population. This is occurrence 9B, at the west side of the Reef. The well developed population occurs at the contact zone of the Dakota Sandstone and Tununk Shale; fossil oyster shells form the gravel surface on the fine textured soil.

Figure 52. SCWR-10 Sclerocactus wrightiae at the North Caineville Mesa population. Plants are scattered sporadically across the summit of the mesa, in places where Masuk Shale clays overlie the capping sandstone. The population was first studied in early May.

Figure 53. SCWR-11 Sclerocactus wrightiae at the Neilson Wash Population. The plant is growing in a mat atriplex community in clay without the usual gravelled surface. Individuals are very widely scattered in this marginal habitat. The picture was taken on the west side of Neilson Wash, with Factory Butte forming the conspicuous landmark in the background.

Figure 54. SCWR-12 Sclerocactus wrightiae at the Giles population. The population occurs on gravelly alluvial fans at the base of the Tununk Shale blackish cliffs in the background. This is the largest individual seen during the inventory.

Figure 55. SCWR-13 Sclerocactus wrightiae at the Lower Blue Hills population. The picture is taken in the Lower Blue Hills about one mile north of the Fremont River and two miles west of White Rock Reservoir. The plants grow on Tununk Shale strata.

Figure 56. SCWR-14 Sclerocactus wrightiae at the Pinto Hills population. This is occurrence 14C, in the South Pinto Hills at the west side of Sand Wash. The population is on benchlands at the base of the Brushy Basin member of the Morrison Formation, which forms the Pinto Hills.

Figure 57. SCWR-15 Sclerocactus wrightiae at the Dry Valley population. Penitentiary Point, of Summerville strata held up by capping Salt Wash sandstone, is in the background. The whitish benchland below the Summerville and in which the plant in the immediate foreground is growing, is the Curtis Formation.

Figure 58. SCWR-16 Sclerocactus wrightiae at the Hanksville South population. The large population occurs in fine sandy loam with large gravels on the surface at the base of steep gray and red slopes. It is near Hanksville at the North end of the South Pinto Hills.

Figure 59. SCWR-17 Sclerocactus wrightiae at the Hanksville North population. The closeup shows detail of the plant morphology and characteristics of the soil microhabitat. The picture was taken one mile north of Hanksville, on gypsiferous soil derived from the Curtis.

Figure 60. SCWR-18 Sclerocactus wrightiae at the Notom population. The site is at occurrence 18B, about one half mile south of the Fremont River.

Figure 61. SCWR-19 Sclerocactus wrightiae at the North Blue Flats population. The plant is at the left bottom corner of the chalk board. This site (occurrence 19A) at the south end of North Blue Flats and one mile north of the Fremont River is more heavily vegetated and with bigger rocks and cobbles than is usual.

Figure 62. SCWR-20 Sclerocactus wrightiae at the Town Wash population. The picture was taken in section 19 of T29S, R10E, looking southward. Such habitat as shown in the foreground (fine-textured, gypsiferous soil which forms a rain crust and has gravels on the surface, in a low-relief, shadscale community) nearly always supports a few individuals of the cactus.

Figure 63. SCWR-21 Sclerocactus wrightiae at the East Blue Mesa (Blue Valley Benches) population. Identification of this unusual cluster of large stems was at first tenative. The plants are growing on an alluvial fan on soil derived from Tununk Shale. The picture was taken at the northeast base of Blue Mesa.

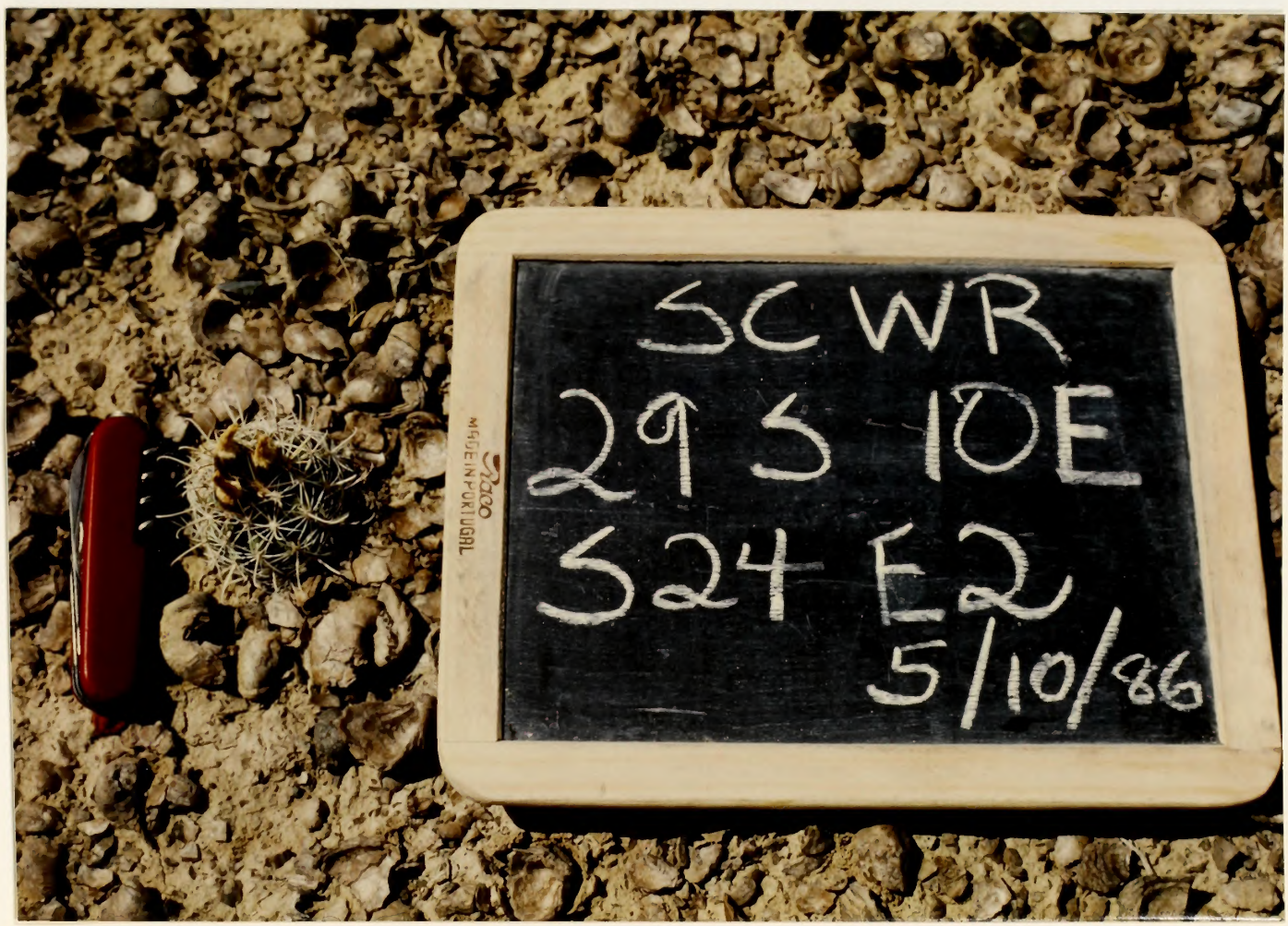


Figure 64. SCWR-22 Sclerocactus wrightiae at the White Point population. The plant is in fruit. The cactus seems to favor sites where fossil oyster shells from the Dakota or Tununk strata form a gravel surface on barren silty clay.

Figure 65. SCWR-23 Sclerocactus wrightiae at the Sandy Creek population. The site is one half mile west of Sandy Creek. This plant is in fruit, but Sclerocactus whipplei, growing in sandstone of the mesa above, was still in bud. The plant flowering to the right of the chalkboard is Xylorhiza venusta.

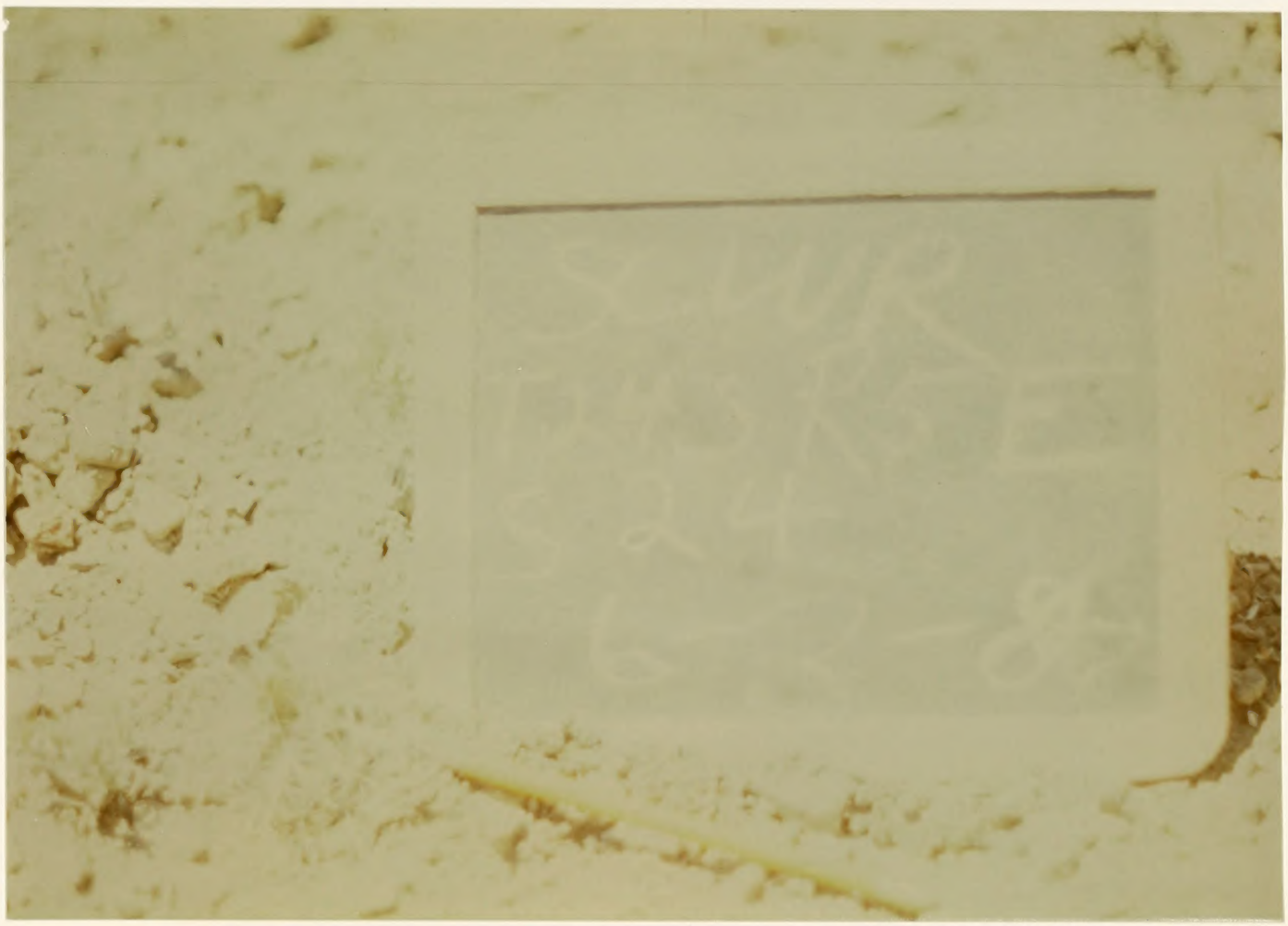


Figure 66. SCWR-24 Sclerocactus wrightiae at the Willow Springs population. Camera failure resulted in severe overexposure of this and other photos taken in Study Area 2. Nonetheless, the cactus (at pencil tip) and location data may be distinguished. The site (occurrence 24A) is one mile southeast of Willow Springs.

Figure 67. SCWR-25 Sclerocactus wrightiae at the Last Chance population. (The photograph was illegible, and is not included). Only one plant was found at the site, one half mile northwest of Last Chance Ranch in Study Area 2. The soil at the site is derived from Curtis and Summerville Formations.

Figure 68. SCWR-26 Sclerocactus wrightiae at the Solomon Creek population. Three plants were found in gravelly alluvial deposits derived from Summerville, Curtis, and Entrada strata. The site is in Study Area 2 on the south side of Solomon Creek.

Figure 69. SCWR-27 Sclerocactus wrightiae at the Rock Springs population. The population is at the north base of Jones Bench in Study Area 2, growing on an alluvial fan at the base of the Curtis Formation.

It is on the Curtis Formation that the specific habitat favored by Sclerocactus wrightiae is most frequently present (Figure 39). We found the cactus to be particularly uncommon on mat atriplex communities of clay flats derived from Mancos Shale, but even here occasional plants (often large) were present. The cactus is undoubtedly present on many sections of the study area where we have not reported it.

In Study Area 2 (Figure 38), the cactus is uncommon in the northern three-fourths where Mancos Shale and Mesa Verde group sandstones predominate. In the southern fourth of the area where the geology is more diverse, populations seem to be more frequent, especially where Curtis Formation strata are exposed. Relatively fewer hours were spent in inventory effort in Study Area 2 than in Study Area 1, but we have demonstrated that the general pattern of restriction of the cactus to a highly specific edaphic regime holds true here as well as in Study Area 1. At the northernmost populations, intermediates with Sclerocactus whipplei occur.

In Study Area 1, intermediates with Sclerocactus whipplei also occur where the distributions of the two species meet. Some individuals cannot be assigned readily to either of the two taxa. However, the characters which separate the two are well correlated with habitat, and the band of intermediates is relatively narrow. Sclerocactus whipplei, which is characterized by somewhat larger average size (plants are usually substantially larger when they first initiate flowering), by longer and denser spination, and by larger and more widely opening flowers, characteristically inhabits more sharply drained and less saline soils; the soil is sandier, and rocky with larger stones and cobbles than is habitat favored by S. wrightiae.

Herbarium specimen label data for Sclerocactus wrightiae, of previous collections and of collections taken during this inventory, are included in the appendix of Volume II.

SPHAERALCEA PSORALOIDES Welsh (Figures 70-75)

Common Name: Scurfpea globemallow

Status: Candidate for Federal listing, Category 2

Original Citation: Stanley L. Welsh 1980. Utah flora: Malvaceae. Great Basin Naturalist 40: 27-37.

Synonyms: none

Description: Stems clustered, from a branched sub-woody base, mostly 6-18 inches tall; foliage sparsely to densely covered with appressed stellate hairs; leaf blades mostly 1/2 to 1 1/2 inches long, divided into 3-5 narrowly oblanceolate segments; inflorescence racemose, the flowers solitary in upper axils; petals 5, orange, about 1/3 to 1/2 inch long. Flowers are shown in Figure 71; a fruiting plant is shown in Figure 73. Plant habit can be seen in figures 71-75.

Sphaeralcea psoraloides can be distinguished from other globe-mallows which grow in the vicinity by a combination of leaf and inflorescence features: its lower leaves are simple or digitately three-lobed, wedge-shaped to rounded at the base, and longer than broad, rather than (as in Sphaeralcea coccinea) 3-5 lobed, cordate, and broader than long; its flowers are borne singly at each node rather than in 2- or several-flowered clusters, as in Sphaeralcea grossulariifolia and Sphaeralcea parvifolia. Its height is intermediate.

Known Distribution: The distribution of Spaeralcea psoraloides in the study area is shown in Figure 70. Until this inventory, few collections had been made of this relatively new taxon. It is known from a band about 7 miles long and 20 miles wide in the North Caineville Reef/San Rafael Swell area.

Habitat Characteristics: The plant grows in salt desert and mixed desert shrub communities, especially with shadscale, Ephedra and Zuckia, on clayey

to sandy semi-barrens. We found it growing on the Tununk member of the Mancos Shale and on the Entrada and Carmel geologic formations, but it is to be expected on other strata in the area as well. Other associated plants are greasewood, Gutierrezia sarothrae, galleta grass, Sphaeralcea coccinea, and S. parvifolia. Representative habitat is shown in figures 74 and 75.

Inventory Findings: Ten occurrences of the scurfpea globe mallow in seven sections, representing a single population, are here reported. Figure 88 itemizes the sections from which it is known. See Volume II for population-habitat data and for Township Findings forms which detail inventory effort. Herbarium specimen label data for Sphaeralcea psoraloides is included in the appendix of Volume II.

The plant does not seem to be particularly rare within its limited distribution. Our collections show a somewhat more variable morphology for the species than indicated in the type description, which was necessarily based on very limited material. Nonetheless, I find it to be mostly well-distinct, as globemallows go, from its near relatives.

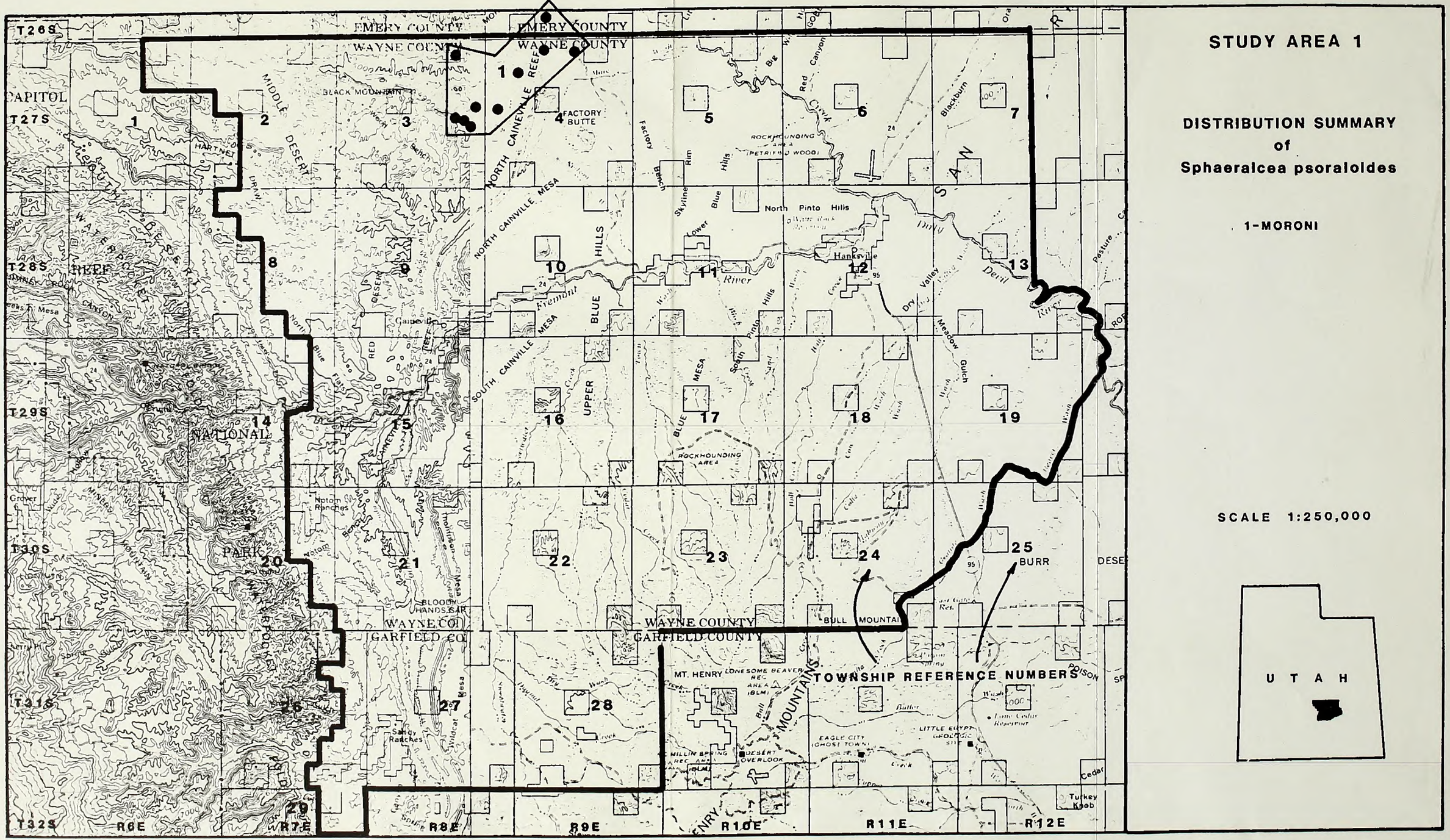


Figure 70. Distribution of Sphaeralcea psoraloides in the Study Area

Figure 71. Sphaeralcea psoraloides (flowering)
The plant is in late flower and fruit in late May. Plants are common at this population at the south end of the Moroni Slopes where they grow in reddish sand derived from the Summerville Formation.

Figure 73. Sphaeralcea psoraloides (vegetation and in fruit) This plant shows dead stems from the previous year as well as fruiting inflorescences. The characteristic thrice-divided leaves reminiscent of those of Psoralea can be seen in this and in the preceding photograph.

Figure 73. Sphaeralcea psoraloides (vegetation and in fruit). This plant arows dead stems from the previous year as well as fruiting inflorescences. The characteristic thrice-divided leaves reminiscent of those of Psoralea can be seen in this and in the preceding photograph.

Figure 74. SPPS-1 Spaeralcea psoraloides at the Moroni Slopes population. The plants are scattered but not uncommon at this location (occurrence 1C) about 3 miles north northwest of Factory Butte. It grows here with Wright's fishhook cactus.

Figure 75. SPPS-1 Sphaeralcea psoraloides, also at the Moroni Slopes population. This occurrence (1D) is near Salt Wash at the base of the Moroni Slopes. The well-developed population is at the base of Entrada sandstone cliffs. Both the photo and the population/habitat data form are mislabeled, and should read "S4, SWNW" not "S8 NWNE". The south end of the Moroni Slopes appear in the background.

TOWNSENDIA APRICA Welsh & Reveal (Figures 76-87)

Common Name: Last Chance Townsendia

Status: Threatened

Original Citation: Welsh, Stanley L. and James L. Reveal 1968. A new species of Townsendia (Compositae) from Utah. Brittonia 20: 375-377.

Synonyms: None

Description: Plant perennial, dwarf, about 1 inch high, from a much branched caudex which arises from a woody taproot; stems compact, the leafy rosettes crowded into small cushions; leaves about 1/2 inch long, sessile, oblanceolate, pointed, without teeth or lobes, closely hairy above and below; flower heads sessile, nestled in the leaf rosettes; rays yellow, tinged with reddish orange on the back; disk corollas yellow with reddish-brown lobe-tips; pappus of disk flowers of about 18 barbellate hairs, these 1/8 to 1/4 inch long, the pappus of the ray flowers much shorter; achenes laterally flattened. Figures 77-79 show characteristics of leaf, flower, and fruit.

Known Distribution: Figure 76 shows the distribution of the Last Chance townsendia in Study Area 2. Except for a few additional stations in Emery County north of Interstate 70, the distribution map shows the total known extant distribution. It is not known to occur in Study Area 1.

Habitat Characteristics: Populations generally occur with galleta and salt desert shrubs in small barren openings of pinyon-juniper communities. Species commonly present in the populations include galleta and blue grama grass, black sagebrush, shadscale, Gutierrezia sarothrae, Indian ricegrass, and little rabbitbrush. The soil may be gravelly and sandy, but most known populations grow in soils that are usually derived (at least in part) from

TOWNSENDIA APRICA Welsh & Reveal (Figures 76-87)

Common Name: Last Chance Townsendia

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Synonyms: None

Description: Plant perennial, dwarf, about 1 inch high, from a much branched caudex which arises from a woody taproot; stems compact, the leafy rosettes crowded into small cushions; leaves about 1/2 inch long, sessile, oblanceolate, pointed, without teeth or lobes, closely hairy above and below; flower heads sessile, nestled in the leaf rosettes; rays yellow, tinged with reddish orange on the back; disk corollas yellow with reddish-brown lobe-tips; pappus of disk flowers of about 18 barbellate hairs, these 1/8 to 1/4 inch long, the pappus of the ray flowers much shorter; achenes laterally flattened. Figures 77-79 show characteristics of leaf, flower, and fruit.

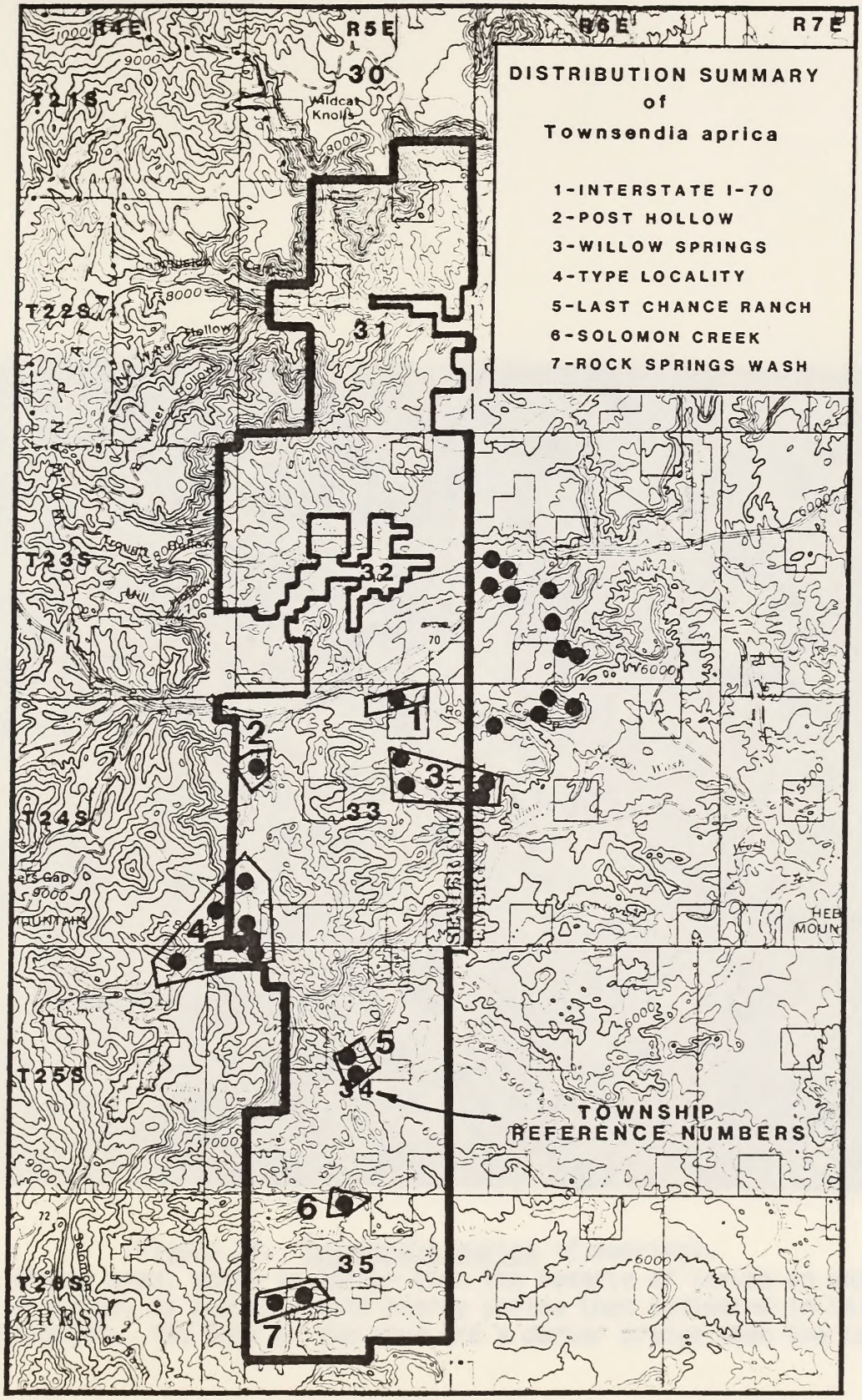
Known Distribution: Figure 76 shows the distribution of the Last Chance townsendia in Study Area 2. Except for a few additional stations in Emery County north of Interstate 70, the distribution map shows the total known extant distribution. It is not known to occur in Study Area 1.

Habitat Characteristics: Populations generally occur with gallets and salt desert shrubs in small barren openings of pinyon-juniper communities. Species commonly present in the populations include gallets and blue grama grass, black sagebrush, shadscale, Gutierrezia sarothrae, Indian ricegrass, and little rabbitbrush. The soil may be gravelly and sandy, but most known populations grow in soils that are usually derived (at least in part) from

shale lens included in the Emery, Ferron, or closely adjacent Mesa Verde Group sandstones. Populations from the southern part of Study Area 2 are in the vicinity of the Curtis/Summerville formations.

Inventory Findings: Ten occurrences of Townsendia aprica in eight sections, representing seven populations, are here reported. Figure 76 shows the distribution of the Last Chance townsendia in Study Area 2. It was not found in Study Area 1. Figure 89 itemizes the sections where it was found. See Volume II for population-habitat data, for the Township Finding forms which detail inventory effort, and for a list of herbarium specimens of this narrow endemic. Figures 80-87 document it at each of the seven populations.

Based on observations of the townsendia's occurrence in the vicinity of the type location and at sites inventoried during search for Sclerocactus wrightiae, as well as on previous studies in similar habitats of Emery County, it is probable that many undocumented populations occur in Study Area 2. In most instances, however, populations are widely scattered and contain few individuals. The plant is to be expected on pale colored semi-barrens wherever clay lens occur on level to gently sloping sandy shelves and benches in the pinyon-juniper zone. Additonal data regarding its occurrence on other geologic strata are needed.



STUDY AREA 2
SCALE 1:250,000

Figure 76. Distribution of Townsendia aprica in the Study Area.

Figure 77. Townsendia aprica (flowering).
The flower head, which is larger than the rosette of leaves on which it is borne, is actually more nearly yellow than indicated in this photograph. The back of the rays are a darker orange than the top.

Figure 77. Townsendia aprica (flowering).
The flower head, which is larger than the rosette of leaves on which it is borne, is actually more nearly yellow than indicated in this photograph. The back of the rays are a darker orange than the top.

Figure 78. Townsendia aprica (in fruit).
In this photograph, the mature flower heads are shattering, releasing the miniature, dandelion-like, wind-dispersed achenes. A single sessile head is borne at the apex of each leaf rosette.

Figure 78. *Townsendia scrica* (in fruit).
In this photograph, the mature flower heads are shattering, releasing the miniature, dandelion-like, wind-dispersed achenes. A single sessile head is borne at the apex of each leaf rosette.

Figure 79. Townsendia aprica (vegetative).
Well developed plants often develop a dozen or more, tightly clustered rosettes of ovate leaves. This clump shows both fruiting and vegetative stems. Each rosette is a scant inch across.

Figure 79. *Townsendia* sericea (vegetative).
Well developed plants often develop a dozen or more, tightly clustered rosettes of ovate leaves. This clump shows both fruiting and vegetative stems. Each rosette is a scant inch across.

Figure 80. TOAP-1 Townsendia aprica at the Interstate 70 population. In order to identify the tiny plant in the photo, an ultra-closeup was required. The soil is very dry, and the ray flowers are brown and shriveled.

Figure 80. TOAP-1 Townsendia aprica at the Interstate 70 population. In order to identify the tiny plant in the photo, an ultra-closeup was required. The soil is very dry, and the ray flowers are brown and shriveled.

Figure 81. TOAP-1 Townsendia aprica at the I-70 population.
This photograph shows typical habitat of the Last Chance townsendia near I-70 in closely-adjacent Emery County. The soil has a high clay component and high shrink-swell properties, as evidenced by surface cracks. A townsendia plant is visible in the lower left corner of the picture.

Figure 82. TOAP-2 Townsendia aprica at the Post Hollow population. The tiny cluster of stems is barely visible at the lower left corner of the chalkboard. Six plants were found in a two-meter square area near the road, about two miles south of Fremont Junction.

Figure 82. TOAP-2 Townsendia aprica at the Post Hollow population. The tiny cluster of stems is barely visible at the lower left corner of the chalkboard. Six plants were found in a two-meter square area near the road, about two miles south of Fremont Junction.

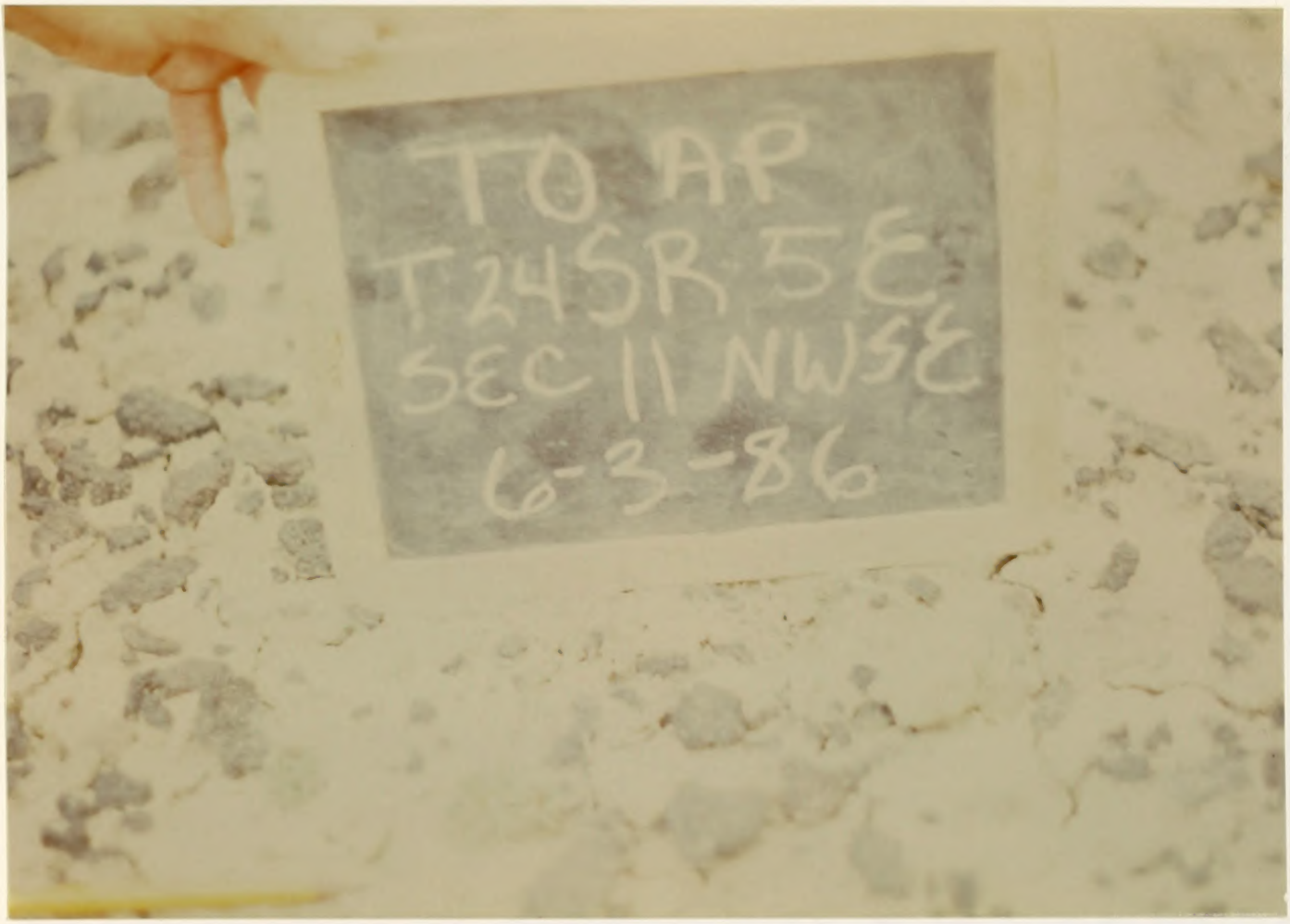


Figure 83. TOAP-3 Townsendia aprica at the Willow Springs population. This and others of the photos taken in Study Area 2 are severely over-exposed. The townsendia plant is not recognizable in the picture, but the pale colored, gravel-surfaced clay substrate is apparent.

Figure 84. TOAP-4 Townsendia aprica at the Type Locality population. The picture shows well the characteristic pale-colored barren clay soil in pinyon-juniper openings where the Last Chance townsendia usually grows. About 250 tiny plants were counted during an hour search.

Figure 84. TOAP-4 *Townsendia aprica* at the Type Locality population. The picture shows well the characteristic pale-colored barren clay soil in pinyon-juniper openings where the least Chance townsendia usually grows. About 250 tiny plants were counted during an hour search.

Figure 85. TOAP-5 This closeup picture of Townsendia aprica was taken near the type locality, and has been substituted for a picture of the Last Chance Ranch population. It shows the characteristic clustering of stems which, in old plants, results in formation of mounds several inches in diameter. The pinyon needles and seedling indicate the vegetative habitat. The ray flowers fold over the heads in this picture, an apparent response to the many-week dry spell. The picture was taken at the beginning of a substantial rain (note raindrops on the blackboard), and a subsequent visit found the daisy-like heads wide open as in Figure 77.

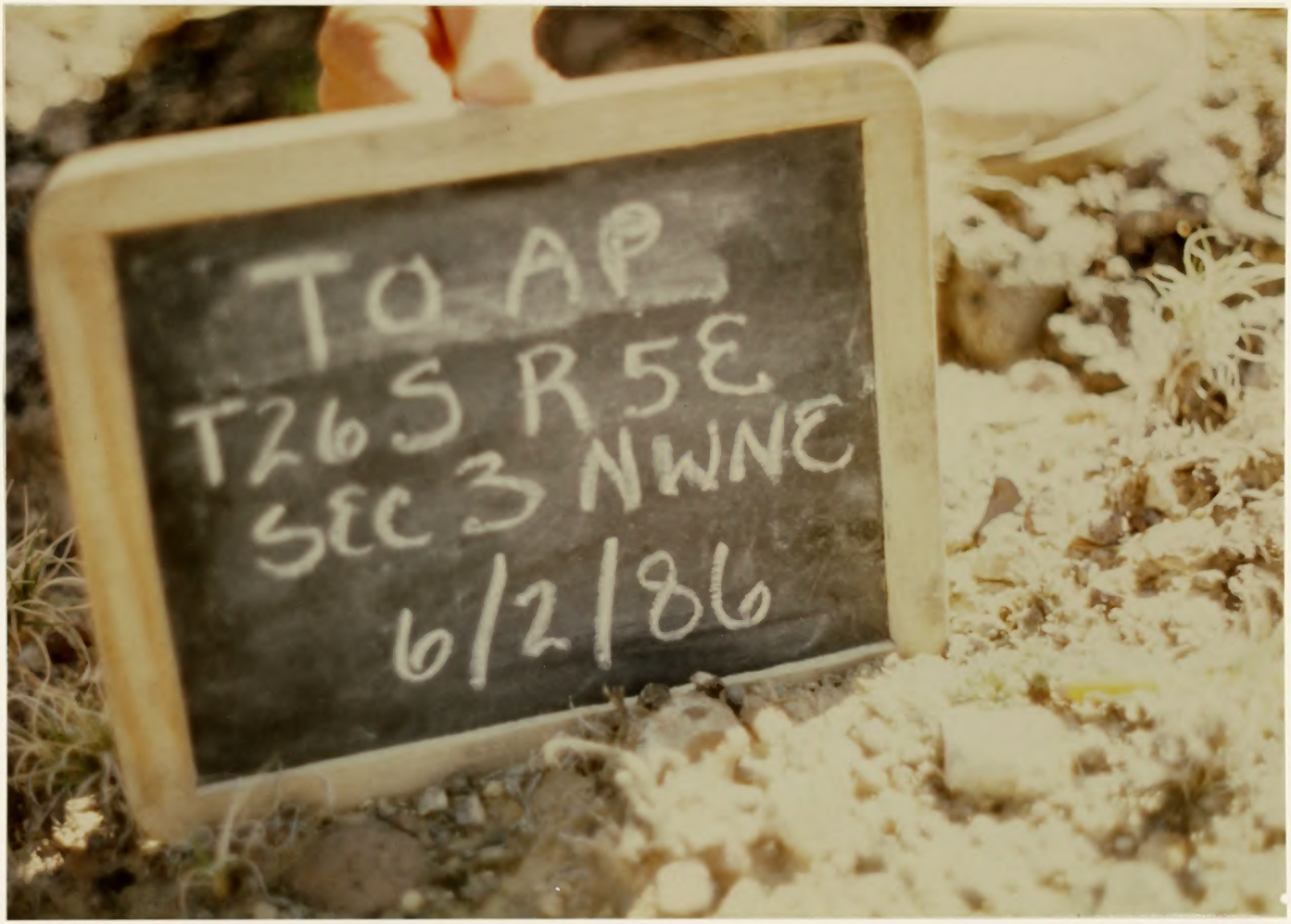


Figure 86. TOAP-6 Townsendia aprica at the Solomon Creek population. The plant is barely visible at the lower right corner of the chalkboard. The population is between Solomon Creek and Temple Wash in Study Area 2.

Figure 86. TOAP-6 Townsendia aprica at the Solomon Creek population. The plant is barely visible at the lower right corner of the chalkboard. The population is between Solomon Creek and Temple Wash in Study Area 2.

Figure 87. TOAP-7 Townsendia aprica at the Rock Springs Wash population. This badly over-exposed picture shows only the location recorded on the chalkboard. The site is about a half mile west of Jones Bench in Area 2, where the plants grow in a characteristic environment of fine-textured, gravel-littered soils at the margin of a P/J woodland.

Record of Area Inventoried on a Section-by-section Basis, with Intensity of Inventory

A progressive detailed record of inventory effort was maintained during field work. Each worker carried with him specifically designed "Township Finding Report" forms, for the most part recording the data on site. These forms are included in Volume II - Record of Area Inventoried. The forms are arranged sequentially by pre-assigned township numbers (See page ii, How to Use This Report). At least one (usually several) forms were completed for each township, depending upon how many different times portions of a particular township were visited. The sections studied in each such reporting unit are itemized under "General Locality" while nature and intensity of search is described under "Description of Effort". In addition, general description of the local topography, geology, and vegetation is provided, as is discussion of positive and negative findings and cross referencing to pertinent maps, population-habitat data forms, and photographs.

A search-priority hiararchy was assigned the various portions of the project areas based on previous familiarity with the specific types of habitat favored by the target taxa, as well as on reconnaisance study. Since none of the target taxa have been reported to occur in dune sand or vegetation types which develop in deep sand, only superficial search was conducted in such habitat. Similarly, none of the target taxa known from the area occur commonly or in abundance in areas of high relief such as cliff faces and steep slopes or on active floodpains; therefore almost all search time was spent on the remaining habitat of benches, mesas, terraces, rimrock, and other near-level terrain. It soon became apparent that concentrations of Sclerocactus wrightiae occur near contact zones of shale and

sandstone geologic strata, where small gravels cover the surface. Inventory personnel thus searched out preferentially sites most likely to support cactus populations, in order to assemble as much data as possible about its occurrence. At all times, during vehicle and foot traverse across the study areas, searchers were alert for each of the target taxa as well as for any unrecognized or rare vegetative components. Figures 88 and 89 provide a summary of all sections in which each of the target taxa were located.

Analysis and Summary of Field Data

In Study Area 1, 180 occurrences of Sclerocactus wrightiae were found. These occurrences, which are in 123 sections, have been grouped into 24 populations. During search for the Sclerocactus, Pediocactus winkleri was found at 12 sites in 9 different sections. Those occurrences have been grouped into 4 populations. Ten occurrences of Sphaeralcea psoraloides in 7 sections were found. Those occurrences have been designated as a single population. Townsendia aprica was not found in Study Area 1. Schoencrambi barnebyi was found neither in Study Area 1 nor Study Area 2.

In Study Area 2, 11 occurrences of Sclerocactus wrightiae were found, located in 10 sections. Eight occurrences of Townsendia aprica were found, in 7 sections. The findings are shown in tabular form below:

	Study Area 1			Study Area 2		
No. of:	Populations	Sections	Occurrences	Populations	Sections	Occurrences
PEWI	4	9	12	0	0	0
SCWR	23	123	180	3	10	11
SCBA	0	0	0	0	0	0
SPPS	1	7	10	0	0	0
TOAP	0	0	0	7	8	10

sandstone geologic strata, where small gravels cover the surface. Inventory personnel thus searched out preferentially sites most likely to support cactus populations. In order to assemble as much data as possible about its occurrence. At all times, during vehicle and foot traverse across the study areas, searchers were alert for each of the target taxa as well as for any unrecognized or rare vegetative components. Figures 88 and 89 provide a summary of all sections in which each of the target taxa were located.

Analysis and Summary of Field Data

In Study Area 1, 180 occurrences of Sclerocactus wrightiae were found. These occurrences, which are in 123 sections, have been grouped into 24 populations. During search for the Sclerocactus, Pediocactus winkleri was found at 12 sites in 9 different sections. These occurrences have been grouped into 4 populations. Ten occurrences of Echinocereus coccineus in 7 sections were found. These occurrences have been designated as a single population. Townsendia aprica was not found in Study Area 1. Echinocereus barnesyi was found neither in Study Area 1 nor Study Area 2.

In Study Area 2, 11 occurrences of Sclerocactus wrightiae were found, located in 10 sections. Eight occurrences of Townsendia aprica were found, in 7 sections. The findings are shown in tabular form below:

	Study Area 1			Study Area 2	
	No. of Populations	Sections	Occurrences	Populations	Sections	Occurrences
PEWI	4	9	12	0	0	0
SCWR	23	123	180	3	10	11
SCBA	0	0	0	0	0	0
SPPS	1	7	10	0	0	0
TOAP	0	0	0	7	8	10

STUDY AREA 1

Township & Range	Pediocactus winkleri (map: page 32)	Sclerocactus wrightiae (map: page 48)	Schoencrambe barnebyi (map: none)	Sphaeralcea psoraloides (map: page 84)	Townsendia aprica (map: none)
T. 27 S., R. 6 E.	not found	secs. 2, 12	not found	not found	not found
T. 27 S., R. 7 E.	not found	secs. 4, 5, 7, 8, 11, 14, 16, 17, 24, 25	not found	not found	not found
T. 27 S., R. 8 E.	not found	secs. 11, 14, 19, 29, 32, 33	not found	secs. 2, 13, 14, 24	not found
T. 27 S., R. 9 E.	not found	secs. 3, 4, 10, 11, 12, 15, 16, 18, 29, 31, 32, 33	not found	secs. 3, 4, 8, 18	not found
T. 27 S., R. 10 E.	not found	secs. 7, 27	not found	not found	not found
T. 27 S., R. 11 E.	not found	secs. 10, 17, 21, 22, 23, 24, 27, 28, 29, 32, 33	not found	not found	not found
T. 27 S., R. 12 E.	not found	not found	not found	not found	not found
T. 28 S., R. 7 E.	secs. 12, 13, 14	secs. 11, 12, 13, 14, 15, 23	not found	not found	not found
T. 28 S., R. 8 E.	not found	secs. 1, 4, 5, 10, 12, 27, 28, 34, 35	not found	not found	not found
T. 28 S., R. 9 E.	not found	secs. 1, 2, 4, 5, 6, 7, 8, 13, 14	not found	not found	not found
T. 28 S., R. 10 E.	not found	secs. 14, 17, 18, 19, 22, 24, 25, 27, 30, 33	not found	not found	not found
T. 28 S., R. 11 E.	not found	secs. 7, 8, 9, 16, 19, 20, 21, 29, 30, 33, 34	not found	not found	not found
T. 28 S., R. 12 E.	not found	not found	not found	not found	not found
T. 29 S., R. 7 E.	sec. 25	secs. 1, 12, 23, 24, 25, 26, 35, 36	not found	not found	not found

(cont. next page)

Figure 88. Occurrence of Target Taxa by Section in Study Area 1

T. 29 S., R. 8 E.	not found	secs. 3. 6. 7. 9. 10, 30	not found	not found	not found
T. 29 S., R. 9 E.	not found	secs. 1, 12	not found	not found	not found
T. 29 S., R. 10 E.	not found	secs. 1, 6, 7, 13, 15, 16, 18, 19, 22, 24, 25(?)	not found	not found	not found
T. 29 S., R. 11 E.	not found	secs. 3, 10, 15, 18, 22, 24, 26, 30	not found	not found	not found
T. 29 S., R. 12 E.	not found	not found	not found	not found	not found
T. 30 S., R. 7 E.	sec. 24 (?)	sec. 1 (?)	not found	not found	not found
T. 30 S., R. 8 E.	not found	not found	not found	not found	not found
T. 30 S., R. 9 E.	not found	not found	not found	not found	not found
T. 30 S., R. 10 E.	not found	not found	not found	not found	not found
T. 30 S., R. 11 E.	not found	not found	not found	not found	not found
T. 30 S., R. 12 E.	not found	not found	not found	not found	not found

Figure 88 (cont.). Occurrence of Target Taxa by Section in Study Area 1

STUDY AREA 2

Township & Range	Pediocactus winkleri (map: none)	Sclerocactus wrightiae (map: page 49)	Schoencrambe barnebyi (map: none)	Sphaeralcea psoraloides (map: none)	Townsendia aprica (map: page 91)
T. 21 S., R. 5 E.	not found	not found	not found	not found	not found
T. 22 S., R. 5 E.	not found	not found	not found	not found	not found
T. 23 S., R. 5 E.	not found	not found	not found	not found	not found
T. 24 S., R. 5 E.	not found	secs. 10, 11, 14, 24	not found	not found	sec. 2, 7, 11, 14, 30, 31
T. 25 S., R. 5 E.	not found	secs. 15, 34	not found	not found	sec. 5, 15, 22
T. 26 S., R. 5 E.	not found	secs. 3, 16	not found	not found	sec. 3, 16, 17

Figure 89. Occurrence of Target Taxa by Section in Study Area 2

STUDY AREA 2

The distribution of the occurrence sites in the populations are mapped and identified on the accompanying topographic maps and on maps, included in this volume, for each taxon. Figures 88 and 89 summarize these findings by sections. Figure 39 summarizes the relative abundance of Wright's fish hook cactus by geologic strata, based on our observations. Documentation of search efforts, locality by locality, are provided in Volume II on Township Finding Report forms. Also included in Volume II are Population-habitat data forms for each occurrence of each of the target taxa.

It is our observations that Sclerocactus wrightiae, a species of narrow geographic distribution, is widely distributed in Study Area I but is largely restricted to a highly specific edaphic habitat. It occurs at least occasionally on essentially all geologic strata of the study area, but is essentially absent from areas of deep sand, from floodplains, and from the pediment benches and ancient, cobbled, well-drained terraces at the north base of the Henry Mountains. Individuals usually occur in small, relatively dispersed clusters. Our endeavors did not constitute a census of the approximately 600,000 acres included in the study areas, but rather a preferentially targeted search of areas deemed of greatest likelihood to support populations of the cactus.

Intermediates with the more common Sclerocactus whipplei, apparently produced through hybridization and backcrossing, are frequent where the habitats of the two meet. A similar pattern of intergradation can be observed for most of the taxa within Sclerocactus where species distributions overlap. However, there is generally good correlation of the morphological features of Wright's fish hook cactus with habitat and geography.

Pediocactus winkleri is apparently considerably more rare and with narrower distribution than is Sclerocactus wrightiae. We found it only in small pockets on nearly level benches where remnants of the Dakota Formation

have contributed much fine gravel to the soil surface.

We did not find any occurrences of Schoencrambe barnebyi in the study areas, and believe it unlikely that suitable habitat for it is present.

Sphaeralcea psoraloides was found to be generally distributed in a small area (between Factory Butte and the Moroni Slopes) near the north margin of Study Area 1. Our numbers probably quadruple all previously known collections of this obscure taxon. It seems to be neither rare nor specific to a recognizable microhabitat in the area where we found it.

Townsendia aprica was found only in Study Area 2. Although it seems to be restricted to small and isolated pockets in semi-barren openings of the pinyon-juniper communities of Study Area 2 and is seldom abundant, our observations indicate that it is likely that it has a somewhat wider distribution than previously known.

An undescribed taxon of Gilia was collected in Study Area 2; formal naming awaits collection of additional material.

CONCLUSIONS AND SPECIES MANAGEMENT RECOMMENDATIONS

Recommendations on Species and Populations Needing Further Monitoring

Pediocactus winkleri

The principal distribution of Winkler's ball cactus, which is a high-priority candidate for listing as Federally Endangered, occurs in Study Area 1. We recommend that careful monitoring of all sites where it is known to occur be conducted several times annually to allow analysis of the degree and type of threat to which it is subjected and to provide information on which a management plan may be based.

Schoencrambe barnebyi

This species nor geologic substrates (the Moenkopi Formation and closely adjacent strata) on which this exceedingly rare taxon are known to grow are not believed to occur in the study areas. Thus, no monitoring is needed.

Sclerocactus wrightiae

The general distribution and specific habitat preferences of this Federally Endangered taxon are now well known in Study Area 1 (perhaps less so in Study Area 2). Because its habitat is present in numerous small pockets almost throughout BLM-administered lands of the Richfield District, monitoring of all populations does not seem practicable nor necessary. We recommend monitoring of selected populations as discussed in the following portion of this report.

Sphaeralcea psoraloides

This candidate (Category 2) species was placed on the Federal Register List because of the paucity of specimens and information about it. Our

limited data indicate that it is probably a fairly common species within its narrow distributional range, and that there are few threats to its continued existence. No monitoring activities are recommended at this time.

Townsendia aprica

This Threatened species recently has been given federal protection under the Endangered Species Act. Thus, federal land management agencies must insure that their management polices do not adversely affect its continued existence. Although general monitoring of the species might best await development of a recovery plan, study and monitoring of the large population in the vicinity where the type was collected should be instigated as soon as possible. At least a portion of that population is currently being severely impacted by cattle grazing and by camping activities of hunters.

Gilia sp. nov.

This distinctive and as yet undescribed taxon requires study. It is a close congener to the Listed Gilia caespitosa which grows nearby in Wayne County. The species is still too poorly known to begin monitoring studies at this time.

Management Implications and Needs,
and Observed and Potential Threats to Target Taxa

Pediocactus winkleri

This Category 1 species, which is scheduled to be proposed for listing in 1987 (England, pers. comm.) may be of greater concern than any other in the study area. The 1986 field season has resulted in accumulation of important addional information about this difficult-to-find little ball

cactus, and suggests that additional, as yet undiscovered, populations may occupy the area.

Three principal types of existing or potential threats exist: trampling by livestock, destruction of individuals and habitat by off-road vehicles, and taking by cactus dealers or growers. The threat from trampling comes from both direct loss of individuals and degradation of the fragile, gravel-littered preferred habitat. Cattle graze in the vicinity of all populations observed during this inventory. Figures 29 and 31 show cattle footprints adjacent to individuals. The area at the Dry Wash population (PEWI 2) is especially disturbed by trampling; apparently cattle move from the grazing land to the west in order to water at Dry Wash. There is also potential for future habitat destruction by powerline, pipeline, or road construction.

The Notom population (PEWI 3), perhaps the largest population known, is between the Fremont River and Notom. This area, near the junction of the Notom Road and Utah Highway 24, receives much use by residents and visitors, due to traffic associated with Capitol Reef National Park, the Burr Trail, Lake Powell, the Henry Mountains, rockhounding, and other recreational and developmental activities. Numerous scarring tracks of ORV's have appeared in the area over the past few years. At a visit to the site in March, 1986, I met a family of six that were rock-hounding at the population site. They had observed Pediocactus winkleri in flower and asked me about it, wishing to know if it could be grown in a garden. This chance encounter suggests that casual visitors may represent substantial jeopardy to individuals of the population. Another indication that collectors are indeed impacting the plant is that both seeds and plants are offered for sale in cactus fancier's catalogs.

Observations as noted above suggest several management implications.

We recommend:

- Additional systematic search for Pediocactus winkleri by botanists intimately familiar with its distribution and habitat requirements. Such search must be conducted during peak flowering. The search might be most appropriately based on aerial photos on which are highlighted all benches of Dakota Formation strata.

- Monitoring of the known populations, especially the Notom and Dry Wash populations where potential impacts are high.

- Protection of the Notom and Dry Wash populations from trampling and ORV use. Since Sclerocactus wrightiae grows at both sites it will be simultaneously protected.

- No land use change or surface disturbance should occur in the area where Pediocactus winkleri grows unless onsite search verifies the absence of the cactus and habitat suitable for its occurrence.

Schoencrambe barnebyi

This species and habitat deemed likely to support it is not now known to occur in the study areas. The two disjunct locations now known are at Sy's Butte in Emery County and along Sulfphur Creek in Capitol Reef National Park. Should additional populations be discovered on habitat types which occur in the study areas, then additional search for this very rare taxon is indicated, since the two known areas of occurrence lie on either side of Study Area 1.

Sclerocactus wrightiae

We are pleased to find, as a result of the inventory here reported, that Wright's fishhook cactus is somewhat more abundant and apparently has a somewhat greater ecological amplitude than was previously known. In Study Area 1, 14 of 23 populations were apparently unreported and undocumented previous to this inventory (i.e. Willow Seep, Moroni, Coal Mine Wash, the Notch, Hartnet Draw, Giles, Lower Blue Hills, Pinto Hills, Hanksville, North Blue Flats, Town Wash, East Blue Mesa, White Point, and Sandy Wash populations). Three of the four populations in Study Area 2 (Last Chance Ranch,

tions). Three of the four populations in Study Area 2 (Last Chance Ranch, Solomon Creek, and Rock Springs Wash) are new. Because of the number of sites from which it is now known, these distributed nearly throughout the study areas, the continued existence of the species seems relatively secure. However, delisting is not recommended at this time since no management plan has yet been devised and implemented which might serve to protect this narrow endemic from gradual encroachment by man's activities on (and resultant destruction of) its habitat.

Threats, both present and potential, have been outlined in the recovery plan (Mutz et al 1982). They consist principally of loss of individuals by cactus collectors, ORV use, and cattle trampling, and by loss of habitat through modification related to grazing, mineral resource development, and road and energy corridor construction activities.

Because of the number of occurrences now known (180) and the presumed existence of many others, monitoring of all known sites and protection of all individuals is probably not possible - nor, we believe, is it the most effective way to manage for the continued long-term existence of this species. Our recommendations follow:

- Continued accumulation of distribution data. As new occurrences of the cactus are found, distribution maps should be updated. We recommend that a set of maps in the Hanksville office be designated as "official" distribution maps, and that an organized procedure be developed to insure that all new sightings are recorded. In addition, if populations are found that represent new distributional and ecological occurrences, we strongly recommend that a properly labeled specimen be made for deposition in an accepted state herbarium.

- Avoidance wherever practicable of destruction or alteration of the cactus' habitat. We recommend that prior to localized surface disturbance or land-management use changes, onsite inventory by individuals trained and familiar with the cactus and its habitat, be conducted to determine presence or absence of "good" habitat for Sclerocactus wrightiae. Generally speaking, pockets of appropriate habitat are small, localized, identifiable, and avoidable. Specifically, development of water resources for use by cattle should be avoided near Sclerocactus wrightiae habitat. Also, a gradual moderate

decrease in level of grazing pressure should be instigated in areas of cactus concentrations.

If any sizable amount of suitable habitat is disturbed, the area should be reclaimed to a pre-disturbance condition by implementation of a site-specific reclamation and revegetation plan. The design of the plan should be based on the specific biological and physical characteristics of the site, and should use native plant species which would hasten site stabilization and the re-establishment of the habitat to pre-disturbance condition (Oliver Grah pers. comm.). If any activity is to result in loss of individuals, a salvage plan, necessarily experimental since little data is available about reestablishment of Sclerocactus populations, should be developed in conjunction with U.S.F.W.S. personnel. Such a plan might appropriately involve seed collection and planting as well as transplant of individuals. Necessity for such costly mitigation efforts may be diminished or eliminated if sufficiently large areas of cactus populations can be permanently protected from disturbance (see below).

- Preservation of the gene pool through protection of selected sites. We recommend that a series of selected sites be set aside and protected from impact. These sites should represent the range of diversity found within the taxon, including diversity of habitat, geography, and plant morphology. Selection of such sites requires careful study, but should include well-developed populations on each of the geologic strata as well as populations which are transitional to each of the phases of Sclerocactus whipplei at the margins of the Wright fishhook cactus distribution.

The single most important step toward achieving delisting of the cactus may be the establishment of protected areas. Since the areas where populations of Wright's fishhook cactus are best developed are often of marginal value for other uses, and because the amount of area occupied by populations are relatively very small, the simplest and most effective management policy might be preserve creation in conjunction with delisting. We recommend that selection of appropriate sites as outlined above be begun as soon as possible, and that until implementation of protection is effected that these sites be monitored on a regular (perhaps quarter-annually) basis.

- Generation and accumulation of ecological, genetic, and biochemical data. Part of the scientific value (and fascination) of this species is in its implications relative to evolution within the Cactaceae. Most of the taxa within this genus are rare and of narrow distribution, are habitat specific, and intergrade with nearby related species. Study of localized populations which represent diversity within the gene pool is central to acumulation of data which can serve to elucidate evolutionary strategies, relationships, and pathways. Although the design and implementation of scientific studies of rare plants may be outside the realm of priority and funding capability of Bureau of Land Management district offices, there are cost- and time-effective actions which the Richfield office may wish to consider that would contribute to its data pool and management capability. Several western universities and colleges have

faculty members who have initiated studies in cactus species of western United States, and who direct graduate students in lines of similar research. The Richfield BLM might well consider offering subsidies such as seasonal housing, travel funds, etc. to assist such research projects.

- Education of land management personnel and the general public. When the distribution of a species which requires protection is as "shotgunned" throughout the area to be managed as is Sclerocactus wrightiae in the Hanksville area, practicality precludes employment of an outside specialist to assist in each management decision which might impact it. It is therefore our recommendation that two or three of the Hanksville BLM staff become sufficiently familiar with Wright's fishhook cactus to insure that in-house clearances of proposed disturbance sites are possible. In addition, we recommend that a training session for BLM field personnel be scheduled, to be taught by a botanist familiar with the taxonomy, distribution, and microhabitat characteristics of Sclerocactus wrightiae and the other species of concern in the Hanksville resource area.

The longterm success of plant preservation efforts depends ultimately on the commitment and knowledgeability of the populace. It is our observation that Hanksville is a community whose residents have extraordinary pride in their land, community, and history. Increased familiarity and understanding of the diverse resources of their land will, in all likelihood, result in increased interest in and cooperation with conservation efforts directed toward protection of unique elements of their natural heritage. Thus we recommend that displays and perhaps a simple native garden which features endemic plants be developed at the BLM headquarters in Hanksville. It is probable that such a project could be planned and developed through volunteer effort.

- Investigation of appropriateness of delisting of Sclerocactus wrightiae. The Endangered Species Act as amended indicates that a final goal of the act is to achieve removal of listed species from endangered or threatened status. Although we think it premature to recommend delisting of this narrowly endemic cactus at this time, we believe that Wright's fishhook cactus has a degree of abundance and distribution sufficient to warrant early planning toward that goal. We recommend that a task force be created to establish requirements and develop guidelines and management policies which will expedite delisting in a manner consistent with requirements of the Endangered Species Act. Such a task force would necessarily include Bureau of Land Management personnel, U.S. Fish and Wildlife specialists, and appropriately qualified botanists.

Sphaeralcea psoraloides

No monitoring of this poorly known narrow endemic is recommended at this time since our few observations indicate it to be locally common, with no severe ecological restriction, and without evident substantial threat.

However, we believe that better understanding of its abundance, distribution, and ecological requirements are needed before reduction of its status to 3C. Therefore we recommend that B.L.M. field personnel working in the Hanksville resource area be trained to recognize the taxon, and that when it is observed to occur in areas other than already documented that properly prepared and labeled specimens be prepared and deposited in one of the principal state herbaria.

Townsendia aprica

Our observations suggest that there may exist numerous previously unknown occurrences of this Threatened species in the Richfield District B.L.M. lands of Sevier County. We recommend:

- General inventory to document distribution and abundance of Townsendia aprica on B.L.M. land in Sevier County.
- Monitoring of known populations. Degree of negative impact to existing populations is poorly known. We observed the microhabitat at the type locality to be both fragile and undergoing severe disturbance. Additional information about population dynamics is needed in order to adequately evaluate kind and degree of threat and management needs.
- Continued accumulation of distribution data by B.L.M. field personnel. We recommend that a set of maps in the Hanksville office be designated as "official" distribution maps, and that an organized procedure be developed to insure that all new sightings are recorded.
- Avoidance of destruction or alteration of habitat where the plant is known to occur. Prior to localized surface disturbance or land-management use changes, onsite inventory by individuals trained and familiar with the species and its habitat preference should be conducted.

Gilia, sp. nov. Studies are needed which document this newly discovered taxon, its morphological variation, taxonomic distinctness, habitat limitations, and distribution. We recommend collaborative effort in order to accumulate such information as needed to complete description of the species and to evaluate its status.

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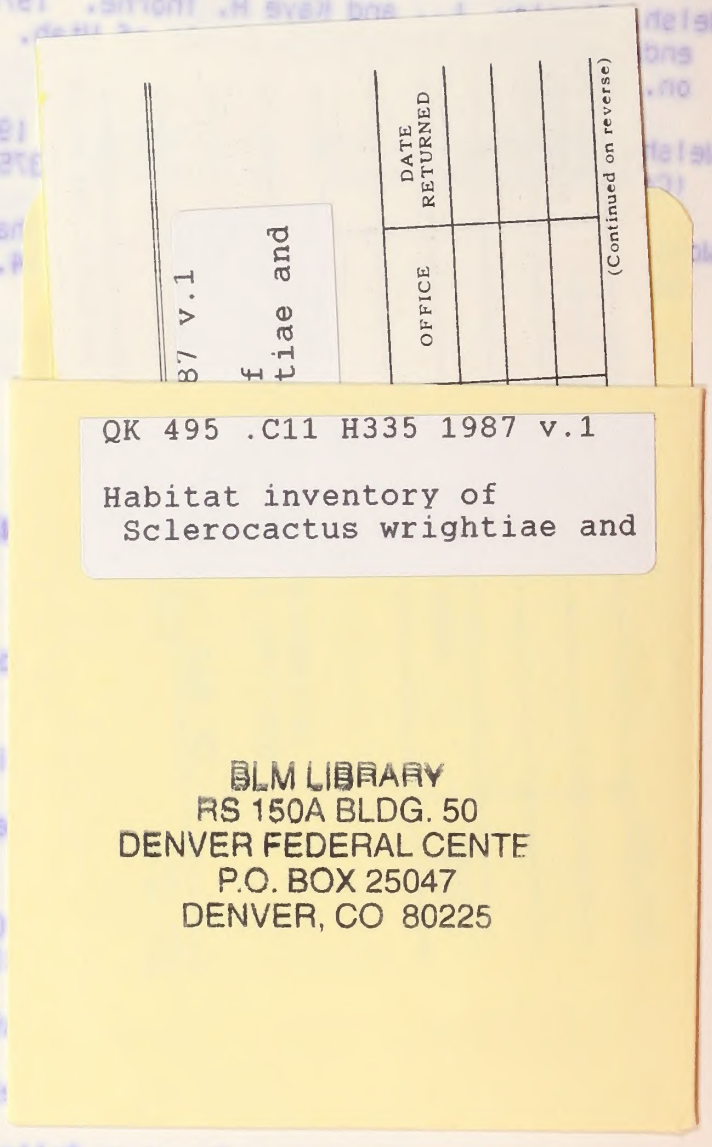
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